SOCIAL SCIENCE IN THE WILDLAND-URBAN INTERFACE: WILDLAND FIRE MANAGEMENT AND RISK IN THE GREATER HOOSIER NATIONAL FOREST AREA; AN INTEGRATED APPROACH

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ABSTRACT

THESIS: Social Science in the Wildland-Urban Interface: Wildland Fire Management and Risk in the Greater Hoosier National Forest Area; an Integrated Approach

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Efforts to suppress wildfires in the past decade have become increasingly difficult. Increased costs, threats to firefighter safety, accumulating fuel from past wildfire suppression, and detrimental impacts to ecosystems have all been compounded by increasing populations in formerly wild space. Although wildfire is typically perceived as a Western problem, the majority of wildland-urban interface (WUI) land is actually in the Eastern United States (Radeloff et al. 2005). Indiana itself has 142 municipalities or census designated places that are at high risk from wildfire (66 FR 751). Many of these WUI communities are in a nine county area in South-Central Indiana in which the Hoosier National Forest (HNF) has landholdings. Increased development and population in this region has resulted in a complex, parcelized landscape with intermixed private and public lands, making wildfire management and mitigation strategies difficult for natural resource professionals. This research addresses perceptions of wildfire and prescribed fire among residents across public/private lands within the WUI in the greater HNF area. It utilizes GIS and key informant interviews as an analytical tool to design a random sample mail survey to gain a better sense of residents' perceptions of risk and their attitudes toward wildfire management and mitigation. Study outcomes will be used to help wildfire and natural resource professionals in the greater HNF area understand the social and physical complexities influencing WUI residents' perceptions of risk and develop strategies based on research findings to build adaptive capacity among WUI residents that is specific and relevant at the local and regional level in South-Central Indiana.

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Very humbly,

Jason M Sprung

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Chapter 1 Introduction

Efforts to suppress wildfires in the past decade have become increasingly difficult. Increased costs, threats to firefighter safety, accumulating fuel from past wildfire suppression, and detrimental impacts to ecosystems have all been compounded by increasing populations in formerly wild space. The approach to managing wildland fires have evolved over time as scientific understanding and the broader context surrounding management decisions have changed. The Healthy Forests Restoration Act (HFRA) of 2003 created a policy shift from predominantly fire suppression to a more complex agenda of suppression, preparedness, mitigation, and community assistance. In addition the nascent concept of fire-adapted communities holds that, with proper community-wide preparation, human populations and infrastructure can withstand the impacts of a wildland fire, reducing loss of life and property (Paveglio et al. 2009; Newman et al. 2013).

Title I of the HFRA defined the wildland-urban interface (WUI) as a community where humans and their development meet or comingle with wildland fuel. It represents a mosaic of people, ranging from families who have owned land for generations to individuals who spend only a few weeks a year visiting a vacation home. Generally, the Federal agencies tasked with wildland fire suppression and mitigation focus on communities where structures directly abut wildland fuels; commonly referred to as interface, or where structures are scattered throughout a wildland area; commonly referred to as intermix (66 FR 751). As of 2014 6.3% of the U.S. population (17.5 million) resided within these areas (Figure 1-1). Also 2.1% of the population lived in WUI areas where more than one fire has occurred (Thomas and Butry 2014). Increased development and population in the WUI throughout the country has resulted in a complex landscape with intermixed private and public lands, making wildfire management and mitigation strategies difficult for natural resource professionals.

Although wildfire is typically perceived as a Western problem, the majority of WUI land is actually in the Eastern United States (Radeloff et al. 2005). Indiana has 142 municipalities or census designated places that are at high risk from wildfire (66 FR 751). Many of these WUI communities are in a nine county area in South-Central Indiana in which the Hoosier National Forest (HNF) has

landholdings. Thesis research began with an expressed need by the HNF to better represent WUI geographic information science (GIS) data, but it has since evolved into an opportunity to research the social implications of wildfire in an often ignored region of the country.

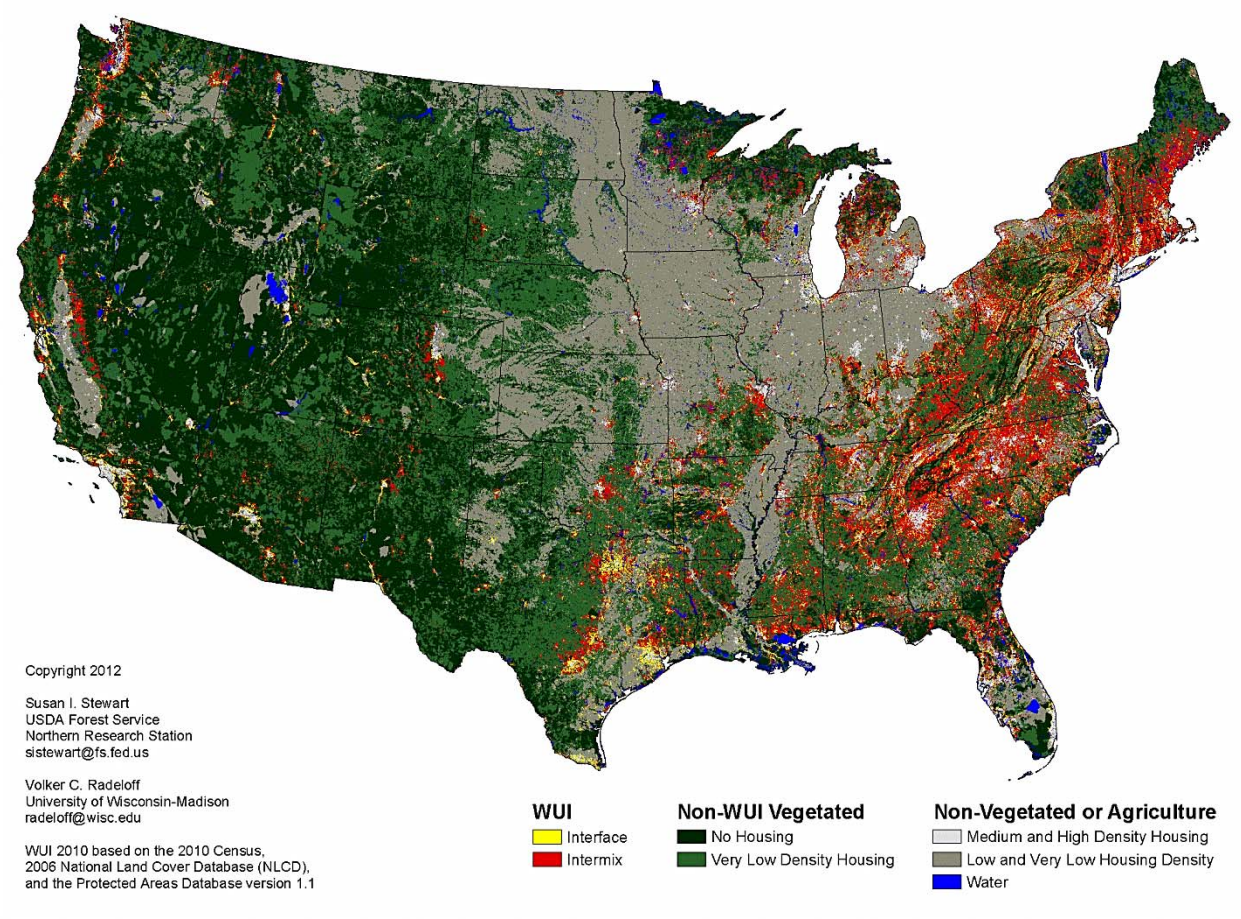


Figure 1-1. National extent of the WUI for the continental United States (Radeloff et al. 2005)

Section 1.1 Statement of the Problem

Because the size and costs of many wildfires in the early 2000's began to reach unprecedented levels, in 2009 Congress passed the Federal Land Assistance, Management, and Enhancement Act (FLAME Act), which directs the Department of Agriculture (USDA) and the Department of the Interior (DOI) to develop a national cohesive wildland fire management strategy (NCS) to comprehensively address wildland fire management across all lands in the United States. The three main goals established

in the NCS are: 1) restoring and maintaining landscapes resilient to fire, 2) establishing fire adapted communities, and 3) implementing safe, effective, efficient risk-based wildfire management decisions.

Addressing fire risk is complicated in the East. During development of Phase II of the National Cohesive Wildland Fire Strategy (2012) the Northeast Regional Strategy Committee identified regional specific issues lending to wildland fire management concerns. In eastern communities, as described in the National Report, the lack of fire on the landscape has created a low public perception of wildfire risk due to a low occurrence of large fires, but having a high risk to life, property, and infrastructure if or when they escape initial attack. Further associated with a lack of awareness of wildfire risks, the Northeast Regional risk analysis report also found there are conflicts and barriers to fire adaptation by a lack of coordination among local land use planning, building ordinances, and building codes. Long intervals between large wildfire events create challenges in investment strategies in preparedness, whether by governments or homeowners. Additionally, wildfire preparedness at the local fire department level can be overshadowed or downplayed because of the responsibility for more frequent all-hazard and medical emergency response.

The HNF is relatively unique in its setting compared to most other National Forests across the nation because the majority of land within the national forest boundaries is privately owned. Forest Service ownership within the purchase boundary is non-contiguous and only accounts for one third of the purchase boundary acreage (Map 1-1). Managing this fragmented and parcelized landscape is a challenge and requires new ways of public interaction and education. In the public/private landscape that makes up the greater HNF area typically 10-30 small wildfires burn during a given year, the vast majority of which occur on private land and are anthropogenic in origin (HNF Individual Fire Report). Because of the highly settled nature of much of the greater HNF area, these human caused fires immediately place homes and property at risk, no matter the size of the fire. Land ownership fragmentation also decreases the efficiency of fire risk management (Busby and Albers 2010). In addition homeowners and recreation users are spread throughout the WUI and may be unaware of the wildfire risks resulting from weather events such as wind storms and drought, invasive plants, and flammable building materials and landscaping.

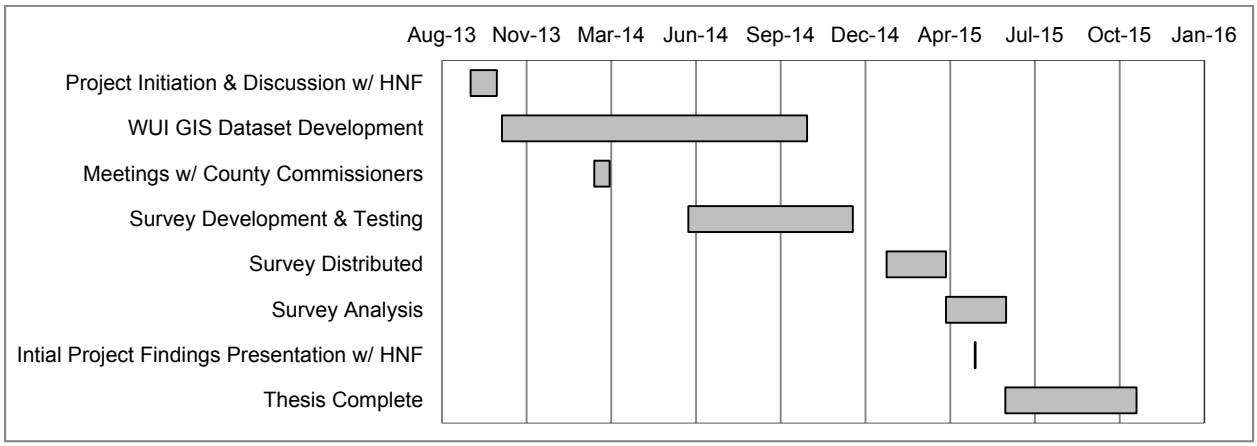
The HNF has an active fuels management program that utilizes prescribed burning as a land management tool for many resource benefits. Because fire has historically played a far greater role on the landscape, public land managers have adopted prescribed burning as a management practice to re-introduce fire to landscapes that have been historically adapted to fire. Some areas are burned to improve Oak/Hickory growth or to restore limestone barrens, while others are burned to increase native grasses and keep the areas open for wildlife. Except in remote areas, prescribed fire can have an impact on members of the public. In the greater HNF area, any fire (whether prescribed or not) will be seen by civilians. As a testament to the WUI situation, most of the Forest's prescribed burns are limited to one or two wind directions due to immediately adjacent smoke sensitive targets (Kolaks, personal communication). When discussing the subject of prescribed fire, adjoining landowners and the public are most concerned about health issues related to smoke or escaped fire. Concerns about escaped fire are enforced by western fire behavior as seen in the media. Therefore it is important to land managers to communicate with the public before, during, and after a prescribed burn. To do this effectively they need to have an accurate idea of what people's perceptions are towards not only the prescribed fire itself, but also their perceptions toward how the Forest Service conducts those burns.

Section 1.2 Research Objectives

This research addresses perceptions of wildfire and prescribed fire among residents across public/private lands within the WUI in the greater HNF area. It will utilize GIS as an analytical tool to design a random sample mail survey. The objective of this research is to characterize the values and attitudes of residents within the WUI to aid wildfire and natural resource professionals in the greater HNF area to: (1) better understand factors that influence perceptions and public understanding of wildfire/prescribed fire management among community members; and (2) develop strategies based on survey findings to build adaptive capacity among WUI residents that is specific and relevant at the local and regional level in South-Central Indiana. This research will help not only the Forest Service and it's planning for wildfire mitigation but should be valuable to the citizens, local county government, and emergency managers of the greater HNF area to plan and prepare for any wildland fire incidents. It also has applicability to other regional Forests, specifically the Shawnee (IL) and the Wayne (OH). It is crucial

because residents and communities make important decisions based on their perceptions and locations within a local landscape (Brenkert-Smith 2006; Gordon et al. 2013; Paveglio et al. 2009). This research was completed approximately one year from time of thesis approval (Table 1-1). Results and final products will be effectively transferred to field managers and other end users through the submission of a completed Master's Thesis for Ball State University, and a presentation of completed thesis research to managers at the HNF office in Bedford, IN. Research findings will also be tentatively submitted to peer-reviewed journals at a later date.

Table 1-1. Thesis Timeline



Chapter 2 Literature Review

Wildfires are and have always been a consistent part of this landscape. What has changed is the degree to which people are affected by them. And as populations continue to shift from urban to rural lands, wildfires will likely pose even greater risks in the future. Landscapes like the HNF are a mosaic of natural and social ecosystems in which fire management is but one of many resource challenges. In order to effectively research the WUI in south-central Indiana, many factors must be considered. These are: the nature of exurban and rural growth in the region, forest fragmentation and land parcelization, the current fire regime of the HNF, land managing agencies policy concerning prescribed fire and wildfire, local fire departments role in the suppression of wildfires, as well as current and ongoing social science research in the WUI.

Section 2.1 Overview of the HNF & Study Area

Indiana is predominantly an agricultural and industrial state. However, there are native landscapes located in the southern Interior Plateau regions of the state. This unglaciated area contains the most topographic relief in the state; typified with rolling to deeply dissected, rugged terrain with areas of karst topography and common medium to high gradient streams. Soils are leached and largely developed from loess, sandstone, siltstone, shale, and limestone. Like other central hardwood forests, the HNF's composition is dominated by oaks, beech, maples, and hickory. On average, the Hoosier is an aging forest with slightly larger trees than the rest of Indiana (Woodall et al 2007). Karst wetland communities and limestone glades (or barrens) also occur and are the major examples of these communities in Indiana. Bounded by the Ohio River to the south, the Forest is within a two-hour drive of the metropolitan centers of Cincinnati, Evansville, Indianapolis, and Louisville. Despite this, the greater HNF area is mainly rural in character with counties and townships (each with varying degrees of responsibility and autonomy) representing the dominant local government. Though agriculture is not as intensive as the northern area of the state; hay, grain, cattle, hog, and poultry farming occur especially in the West and in the wider valleys.

Figure 2-1. Erosion on Sec 23, 6S, 3W, northeast of Tell City (6/16/1937)

Prior to 1935 the Forest Service had no presence in Indiana. In contrast to national forests in the western United States, the Hoosier National Forest is comprised of land that was previously inhabited for many years and extensively modified. The southern Indiana region was originally settled by farmers from Virginia, North Carolina, and Tennessee, predominately of Scotch-Irish ancestry, who brought a subsistence-based agricultural economy with them in the early 19th century (Nation 2005). The lands that are now the HNF were cleared of timber between 1870 and 1910, so much so that in 1899 Indiana was first among states in timber production (Shands 1992). Land that had been clear cut for timber was converted to agriculture which initially produced good yields, but soon over cropping and erosion had severely damaged farmlands (Figure 2-1). During the Great Depression, state Legislatures in the Midwest came forward and asked for assistance reclaiming and managing their marginal lands under Federal ownership. The Forest Service was established in Indiana in February 1935 after the Governor and 73rd Indiana Congress passed an Enabling Act. The Act contained no limitation on acreage. By mid-1936 the Forest Service had about 35,000 acres in Indiana approved for purchase. The Forest Service's immediate goals were to rehabilitate the damaged land, control wildfires, and acquire lands suitable for timber production. After 1951 the original purchase units officially became a National Forest. By 1982 the Charles C. Deam Wilderness (Indiana's only congressionally designated wilderness area) was established with 13,000 acres of protected land.

Since its initial purchase of 1,597 acres of abandoned farmland, the land base has gradually grown and is now approximately 203,098 acres. Yet this total Forest Service acreage only accounts for one third of the purchase boundary acreage (Map 1-1). The pattern of HNF land holdings is highly fragmented due to the incremental acquisition of land through purchases of private lands in and near the existing HNF land holdings and the establishment of four distinct management units. These four management units; Pleasant Run, Lost River, Patoka River, and Tell City, are not contiguous and are spread throughout a nine county area in South-Central Indiana. Today the HNF comprises about half of the public forest land in Indiana. It does not exist as an intact island within the surrounding forests of Indiana; instead it is a forest ecosystem intermixed with private forest in a State that depends on its forest resources for its livelihood (Woodall et al. 2007). It has a key role in providing forest ecosystems which enhances biological diversity on a regional scale as well. Timber harvests, prescribed burns, wetland development, wildlife habitat improvement, and other practices occur in areas defined for appropriate uses.

The HNF is in the center of a triangle formed by large urban areas. It has three major population centers to its north, southeast, and southwest: Indianapolis, Louisville, and Evansville, respectively. Each center generates commercial, economic, and social impacts on the HNF (Welch et al. 2001). In communities subjected to substantial and rapid population growth, such as Monroe County, there is greater popular division over access and use of HNF and greater diversity in the value of the forest than in other communities (Welch et al. 2001).

The study area for this research is the greater HNF area. This is the nine county area in South-Central Indiana in which the Forest Service has landholdings (Map 2-1). It consists of Brown, Monroe, and Jackson (Pleasant Run); Martin and Lawrence (Lost River); Orange (Patoka River); Perry and Crawford (Tell City); and Dubois counties. Sociodemographic information for the greater HNF area is summarized in Table 2-1.

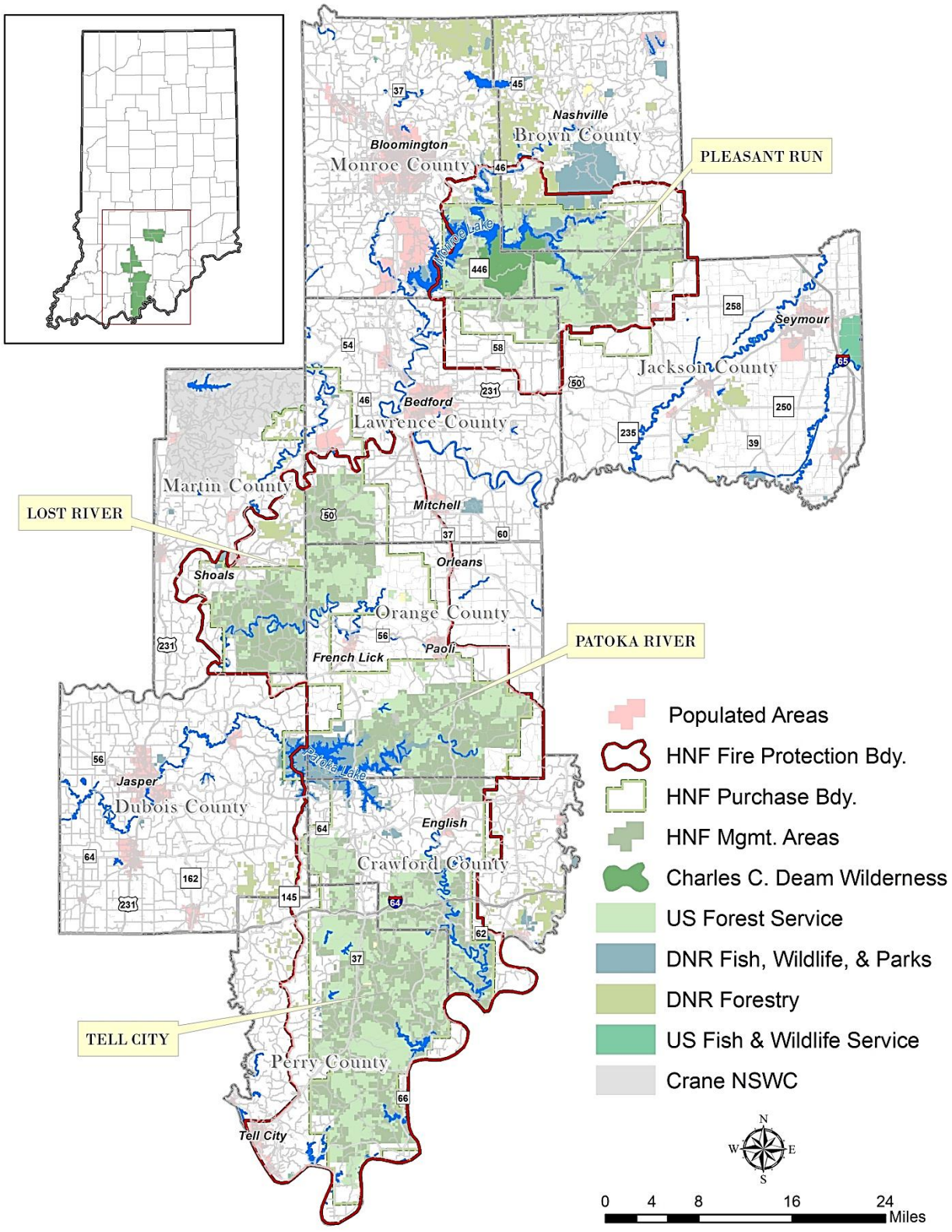
Brown County has a population of 15,242, a higher percentage of retiree aged residents, high numbers of second and seasonal homes, and is heavily reliant on tourism because of its close proximity to the state's largest park (Brown County State Park), original artist's colonies, as well as the Pleasant Run unit of the Forest. Monroe County, with a population of 137,974, is the fastest growing and most

populated county in the greater HNF area. Home to young, educated populations in Bloomington (pop. 80,405) and Indiana University, it is a busy economic and social hub for South-Central Indiana. Most of the Charles C. Deam Wilderness and Monroe Lake are within minutes of this large urban area.

Jackson, Lawrence, and Dubois counties with higher populations (42,376; 41,889; and 46,134 respectively) are diverse areas with many people employed in the service sector as well as manufacturing. The economies of Jackson and Dubois also differ from the other counties in the Hoosier Region in their dependence on farming, although most farming activity occurs a distance away from the HNF. Lawrence, with the large town of Bedford (pop. 13,380) and its important limestone industry is more "blue collar" with higher poverty rates and unemployment. Martin County with a population of 10,334 is the smallest county in the greater HNF area. It is distinct from the other counties in that it has experienced a slight population loss from 1990 to 2010. Martin County is also heavily influenced by the 56,000 acre Crane U.S. Naval Surface Warfare Center, which exists in the northern area of the county.

Crawford and Perry counties are in the extreme southern part of the state. With a population of 10,713 and 19,338 respectively, they are similar to smaller counties in the greater HNF area in that they are characterized as rural, but both counties have high levels of poverty and unemployment, lower levels of educational attainment, and a greater reliance on primary industries like agriculture and forestry. Within Perry and Crawford counties, there has been a trend of exurban growth from nearby cities. Perry County with the town of Tell City (pop. 7,292) is becoming known as the "inexpensive Brown County" of southern Indiana, and Crawford County is strongly influenced by the city of Louisville (Welch et al 2001). Orange County with a population of 19,840 has the largest population within the HNF's boundaries, with nearly a quarter of the county's population residing in Forest Service management areas. The county has a significant amount of WUI due to the proximity of the resort towns of West Baden Springs/French Lick (pop. 2,381) as well as the town of Paoli (pop. 3,659) to large tracts of Forest Service land as well as above average numbers of seasonal homes near Patoka Lake.

Demographic information summarized above provides a representation of the social and cultural structure of the region. The socioeconomic environment of the Hoosier Region and the evolution of this environment provide an important context that land managers can use to make decisions.



Map 2-1. Greater Hoosier National Forest Area.

Table 2-1. Selected US Census & Bureau of Labor Statistics Data for Counties in the Greater HNF

	Brown	Monroe	Crawford	Perry	Martin	Dubois	Lawrence	Orange	Jackson
Total Population (2010)	15,242	137,974	10,713	19,338	10,334	41,889	46,134	19,840	42,376
% Population Change (1990-2010)	+ 8.3	+ 26.6	+ 8.1	+ 1.2	- 0.3	+ 14.4	+ 7.7	+ 7.8	+ 12.3
% Rural Population (2010)	100	21.3	100	55	72.3	49.3	58.5	83.5	43.7
% Urban Area Population (2010)	0	78.8	0	0	0	0	0	0	0
% Urban Cluster Population (2010)*	0	0	0	45.0	27.7	50.8	41.6	16.5	56.3
Rural Population Density (2010)	48.9	83.8	35.1	28.2	22.4	49.9	62.1	41.8	37.5
HNF Population (2010)	1,488	4,017	6,035	5,056	2,375	2,041	5,472	8,607	2,607
HNF Housing (2010)	729	2,360	3,308	2,330	1,155	906	2,452	4,122	1,172
HNF FPB Population (2010)	2,265	2,778	6,321	17,742	3,090	1,454	8,463	17,702	2,551
HNF FPB Housing (2010)	1,102	1,377	3,441	7,754	1,512	657	3,807	8,301	1,144
HNF Mgmt. Areas Population (2010)	917	776	2,755	5,117	1,484	377	2,101	4,556	1,448
HNF Mgmt. Areas Housing (2010)	493	472	1,420	1,743	715	167	998	2,263	647
Median Age (2007-2011)	46.8	27.6	41.5	40.6	42.1	39.7	41.0	40.0	38.1
% w/College Education (2007-2011)	29.4	48.2	17.4	17	20.7	28.3	20.2	17.5	20.9
% Employed w/Agriculture or Forestry (2007-2011)	1.2	0.5	3.8	4.5	4.6	3.9	1.7	3.3	3.2
Per Capita Income (2007-2011)	$25,418	$22,306	$19,202	$21,298	$22,148	$25,355	$22,189	$18,811	$22,062
Median household income (2007-2011)	$50,503	$38,524	$40,354	$45,808	$43,592	$53,997	$43,195	$37,618	$45,666
% Below Poverty (2007-2011)	11.2	25.3	18.5	10.1	14.4	8.5	15.8	18.1	12.7
Unemployment Rate (8/2013)	6.9	7.6	9.7	8	5.9	5.1	9.4	8.1	6
Presidential Election (2012)	Rep.	Dem.	Rep.	Dem.	Rep.	Rep.	Rep.	Rep.	Rep.
% USFS Land w/County	8.5	9.2	12.2	29.8	4.8	0.2	8.0	16.0	11.3
% Public Land w/County	19.3	13.2	11.4	18.9	5.3	2.9	5.2	12.6	11.2
Public Land as % of County Area	32.4	17.6	19.5	25.9	8.3	3.5	6.1	16.6	11.5
Median value of owner-occupied homes (2007-2011)	$159,000	$151,000	$86,200	$95,400	$85,400	$133,100	$99,500	$91,400	$117,400
Renter Population (2010)	2,413	53,559	1,715	3,809	1,737	8,203	10,052	4,528	10,929
% Total Population Renting (2010)	15.8	38.8	16	19.7	16.8	19.6	21.8	22.8	25.8

* US Census Urban Cluster - of at least 2,500 and less than 50,000 people

Section 2.2 Landscape Dynamics of the WUI

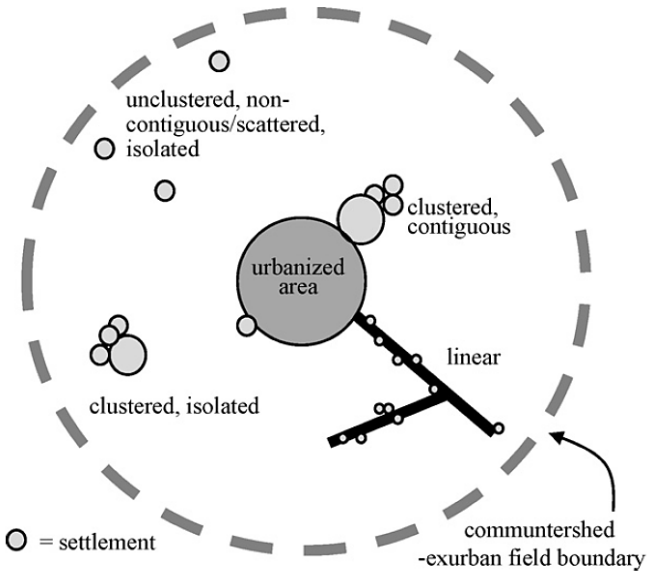


Figure 2-2. Exurban settlement patterns (Clark et al. 2009)

While the wildland urban interface was defined previously in Chapter 1 as a community where humans and their development meet or intermix with wildland fuel, the WUI problem may best be thought of as a symptom of the larger demographic trend in the United States - exurban growth. Exurbia is the low-density residential landscape that consists of urban-dependent settlements within the commutershed of urban areas (Figure 2-2). Numerous structural factors have driven exurban growth in this country including economic restructuring, homeowner tax deductions, government mortgage guarantees, automobile adoption, road building, and mass production of housing (Johnson 2008). The end result is increasing demand for residential, retail, and service sector development in previously rural areas (Beale and Johnson 1998; Nelson 1997).

Exurbanites reside in rural areas although they do not earn a living from the land. They are *in* the country, but they are not *of* it. This is dramatically different than previous population demographics in rural areas prior to World War II (Johnson 2008). They are different from suburbanites in that exurbanites want to live an "extended suburban lifestyle" typified by large, inexpensive, and most importantly, private home sites (Nelson and Sanchez 1999). Main motivators for seeking a residence in an exurban setting

include rising demands for quality-of-life attributes associated with residential living, affordability, avoiding negative urban aspects, natural amenities and outdoor recreation, migratory retirement decisions, telecommuting, and the strong predisposition toward an idealized rural and small-town life in American culture (Marcouiller et al. 2002).

These areas, located well outside established urban and suburban boundaries, have witnessed a disproportionate amount of population growth and new land settlement in recent decades (Berube et al. 2006; Fulton et al. 2001; Heimlich and Anderson 2001). From 2000 to 2007, the population of exurban counties around metropolitan statistical areas grew by 13.1% (Mackun 2009). In comparison, the number of persons living in central counties, containing cities and suburbs, grew at a slower rate of 7.8%, while the country's population as a whole increased only 8.2% during this period (Mackun 2009). Nationwide, amenity-rich rural areas outpace most other rural places in terms of population growth, housing values, and economic activity (Beale and Johnson 1998). This growth in formerly wild space – in predominately Western states – has led to the wildfire and WUI problem as it is presently understood. WUI land in the country has expanded by 52% between 1970 and 2000 (Theobald and Romme 2007), and as of 2014 6.3% of the US population (17.5 million) resided within WUI areas. Of the 17.5 million residences, nearly a third (33.3 %) of the population resided in areas where more than one fire has occurred (Thomas and Butry 2014).

Unlike Western states, where natural amenities and outdoor recreation are major draws for exurban residences, exurban growth in Midwestern states like Indiana are influenced primarily by the affordability of land and housing, the privacy associated with rural living, and family and social networks (Johnson 2008; Johnson and Schultz 2011). Certain areas of the greater HNF area exhibit aspects of both affordable and amenity rich landscapes as supported by easy accessibility to Monroe and Patoka lakes, available public land and forests, the Charles C. Deam Wilderness, and 260 miles of recreational trails (Figure 2-3).

Figure 2-3. Example of exurban growth in the greater HNF area. Approximately 50 seasonal residences within 0.3 mi^2 & less than 60 yds from USFS land (near Greenbriar, IN 11/21/2014)

Such growth and development is not without environmental and social cost. Demographic processes, notably migration and population growth and redistribution, are profoundly changing landscapes and ecosystems across the United States. These environmental concerns are all the more significant considering that the same natural amenities that appeal to tourists and residents alike — coastal, riparian, and mountain regions —are among the least resilient to human development and interaction (Hersperger 1994). With increased growth in formerly rural areas, there is the potential for community conflict and disagreement when the views of amenity migrants, tourists, and long-term residents clash on not only land use issues but social ones as well (Green et al. 1996; Spain 1993). Coexisting with newly arrived, affluent WUI populations are working class, poor or otherwise socially vulnerable populations. The latter groups typically experience greater losses from environmental disasters such as wildfire because lower income residents are less likely to have established mitigation programs in place to help absorb loss (Poudyal et al. 2012). Due to increased growth, communities across the country are struggling to slow forest fragmentation and loss, and the associated decline of rural character, wildlife habitat, and water quality (Perry et al. 1999). Likewise, exurban shifts in population characteristics create new challenges for traditional, resource-based industries such as farming and forestry (Mather 2001). As new buildings, roads, and other infrastructure are constructed in forested areas, individual forest stands

become fragmented, creating new forest edge and increasing the exposure of forests to urban stresses as well as changing the species composition of forests or the introduction of invasive species (Medley et al. 1995). Different from fragmentation but often related, parcelization, or the subdivision of land parcels, frequently leads to conversion of forestland to developed uses (Zipperer and Birch 1993; Thorne and Sundquist 2001; Mundell et al.2010). In the upper Midwest, forest parcelization has both directly and indirectly limited the likelihood of oak stand regeneration (Knoot et al.2009). Parcelization also decreases the efficiency of fire risk management. Busby and Albers found that in areas where ownership is mixed, private landowners perform too little fuel treatments as they ‘‘free ride’’—capture benefits without incurring the costs—on public protection, while areas with public land only are under-protected (2010).

Nowhere is the stress associated with exurban growth more evident than in the nation’s national forests. The Forest Service estimates that between 2000 and 2030, a substantial increase in housing density will occur on more than 21.7 million acres of rural private land (8% of all private land) located within 10 miles of national forests (Stein et al. 2007). The Forest Service projects the US could lose approximately 6 million hectares of forest land from 2002 to 2050, primarily to residential development (Haynes et al. 2007). Much of this development will occur as exurban growth (Theobald 2001; 2005; Cova et al. 2004). In the East, almost all national forests are projected to experience moderate or high increases in residential development. In the HNF, 22% of private lands within 10 miles of USFS land are projected to undergo some sort of increased development (Stein et al. 2007). Over the past decades, southern Indiana has experienced forest regrowth on private lands, but this regrowth has declined recently with increased conversion of open space for residential development (York and Munroe 2010).

The characteristics of exurban forests in Indiana are not unique to the Midwest. The number of private forest land owners in the US increased by 11% between 1993 and 2003. Most of this increase has occurred among owners with less than 50 acres of forestland (Butler and Leatherberry 2004). Parcelization in particular has grown as a concern in the Indiana Department of Natural Resources (IDNR) and the Forest Service. Roughly 85% of the state’s forestlands are privately owned (Figure 2-4); and of those almost 90% are individuals or “family forest owners” with an average forest tract of less than 25 acres (Bratkovich et. al 2004). Only a small percentage of Indiana landowners actively manage their forests for the resources they provide (IDNR 2008). The reasons for owning forestland have not changed

appreciably over the past decade. That the land is part of a home or farm remains important to many owners. However, the relative importance associated with some reasons for ownership has changed. For example, owning land to pass along to heirs, for aesthetic enjoyment, and for land investment have increased in relative importance, while owning for timber production has decreased (Butler and Leatherberry 2004). As recreational and aesthetic values of private forest land supersede production values, the availability of marketable timber could decrease in the coming years (Carman 2013). The sustainability of Indiana's forests is at a turning point, with forest inventories giving early indications that forest acres may be in decline. Aging owners, which control a large percentage of Indiana's forests, are projected to liquidate ownerships at a rapidly accelerating pace (IDNR 2008). In southern Indiana, research has found that individual properties are in most cases diversified entities with about two-thirds of landowners managing their parcels as multiple land-use units. In general, increased land-management complexity is positively related to more fragmented patterns of land cover in southern Indiana (Donnelly 2011). In Monroe County (one of the counties in the greater HNF area), changes in the composition of the landscape, particularly the amount of land covered by forest or agriculture, strongly correspond with parcel boundaries (Croissant 2004). Despite myriad concerns about the adverse impacts from parcelization, there is no agreement on how to tell when or if a landscape has become parcelized in the first place, or whether it has passed a threshold such that adverse impacts begin to occur (Kilgore et al. 2013).

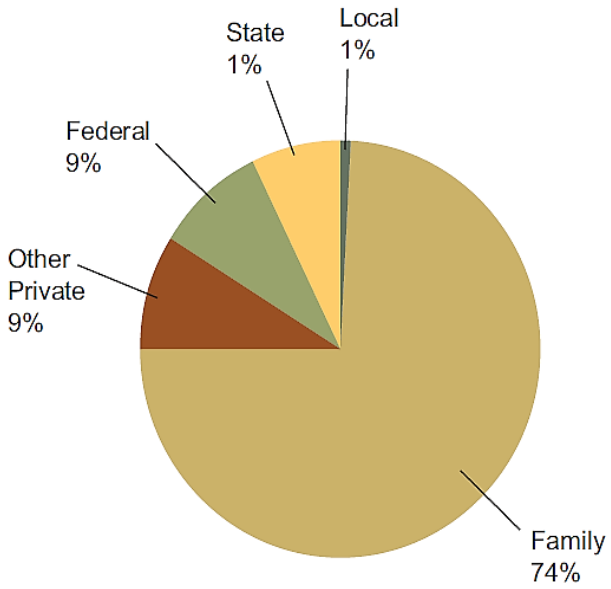


Figure 2-4. Distribution of forest land by public & private ownership, Indiana, 2004-2008 (NRS-45)

Local planning and public policies significantly affect the retention and stewardship of Indiana's private forestlands. Conversely local policy can accelerate the break-up of forestland and conversion to non-forest uses. Institutional constraints such as growth management policies or urban growth boundaries are a means to protect agricultural and forestland, yet traditional zoning remains the most prevalent land-use control in the US, especially in rural regions (Diamond and Noonan 1996). Indiana's enabling legislation allows county-level zoning, passed in 1935 (Snider 1940), but the state has never adopted any requirements for zoning and planning. If forest land is developed, many of the forest-based goods and services are permanently lost.

Section 2.3 Fire Management in the HNF

The combined effects of climate change, land-use change, and increasing numbers of invasive species are the primary threats to Midwest natural ecosystems (Dale et al. 2011). Midwest forests are more resilient to forest carbon losses than most Western forests because of relatively high moisture availability, greater nitrogen deposition, and lower wildfire risk (Birdsey et al. 2006; Reich 2011; Williams et al. 2012). Despite this, climate change may have an impact on what types of forest may be around in the foreseeable future. Climate models have projected significant increases in temperature over

the next century for the Northeast and Midwest. Temperature records show that the length of the growing season is increasing and that rapid freezing events are more common in the early spring. As a consequence, the composition of the region's forests is expected to change as rising temperatures drive habitats for many tree species northward (Hellmann et al. 2010; Iverson et al. 2008; Swanston et al. 2011). The impact this ecological shift will have on the current fire regime of Indiana is uncertain.

Fire typically conjures images of destruction. However, most forests rely on fire to reduce dense underbrush, restore nutrients to the soil, and provide important wildlife habitat. Fire has historically played a significant role in Indiana both before and after European settlement (Olson 1996; Guyette et al. 2003). Modeling based on inputs of climate, population density, fuel dynamics, seasonality, and species susceptibility estimate that the mean fire interval for the period of 1650-1850 varied from 8-12 years in southern Indiana (Stambaugh et al. 2010). Empirical research has found that fire intervals for the period of 1656-1992 was around 8.4 years based on tree ring analysis using dendrochronology in the Boone Creek watershed of Perry County, IN (Guyette et al. 2003). Since lightning is usually accompanied by rain in the Midwest and no correlation can be made between drought and historic fire occurrence, most all fire in the Central Hardwood Region is, and was, anthropogenic in origin (Guyette et al. 2003). It is widely believed that this anthropogenic burning led to the development of fire adapted communities of vegetation like oak/hickory and barrens (Smith 2005; Robertson and Heikens 1994; Hutchinson 2006).

Due to 20th century fire suppression, the historic fire-adapted systems have been invaded—and in some cases replaced. In addition an extensive road system in the East has facilitated suppression, artificially subduing historic levels of fire occurrence. Because of this, fire regimes and natural vegetation patterns have been significantly altered (Table 2-2). This has led to the demise of many fire tolerant species of oak in favor of mesic (moisture and shade tolerant) vegetation like maple and beech in many forests of the Central Hardwoods Region (Nowacki and Abrams 2008). On the HNF the regeneration of oaks in oak forest types is sparse, indicating the possible loss of oak forests in the future (Woodall et al. 2007).

Table 2-2. Fire Regimes & Vegetation of the Greater HNF Area (USGS LANDFIRE)

Fire Regime	Return Interval	Severity	Dominant Vegetation	Veg. Condition Class[4]
Group I	≤ 35 yrs	Low & Mixed[1]	Calcareous Glade & Woodland; Ruderal Forest - Northern & Central Hardwood & Conifer	High Departure
Group II	≤ 35 yrs	Replacement[2]	Chestnut Oak - White Oak - Red Oak Forest	High Departure
Group III	35 - 200 yrs	Low & Mixed	Sugar Maple - Yellow Poplar - American Beech - Oak Forest; Green Ash - American Elm Forest	Moderate Departure
Group V	> 200 yrs	Any[3]	American Beech - Yellow Birch - Sugar Maple; Agriculture	Moderate Departure

1.Low & Mixed Severity: replacing < 25% of dominant overstory veg; can include mixed severity that replaces up to 75%

2. Replacement Severity: replacing > 75% of dominant overstory veg.

3. Any Severity: can include any severity type (low to replacement)

4. Vegetation Condition Class: categorizes departure between current veg. conditions and historical veg. conditions

This ecological shift in forests due to a change in fire regime has led to the adoption of prescribed burning as a restoration and management technique on public land. The Forest Service's five year strategy for restoring fire adapted ecosystems in the Eastern region seeks to develop landscape scale treatment strategies among agency partners to provide ecological condition class restoration and hazard abatement, based on ecosystem health rather than organizational barriers (USFS Five Year Strategy). Because so many national forests in the East have noncontiguous land, a multi-tiered and multiscale treatment strategy is to be addressed on a case by case basis with respective Forest's Land Resource Management Plans and Fire Management Plans. In its most recent Land Resource Management Plan (LRMP), the HNF had increased its effort in re-introducing fire to barrens in the Cover Lick and Boone Creek special areas through prescribed burning of upland vegetation (HNF LRMP 2006). The optimum time for prescribed burning for oak regeneration is late spring just before or during leaf expansion (Brose et al. 2006). Prescribed fire techniques applied on the Hoosier result in what is generally considered low to moderate intensity burning (Figure 2-5). In most instances burned areas are relatively indistinguishable from adjacent unburned areas unless the burned area is part of a restoration effort. Despite having a lack of personnel and equipment, HNF fire personnel through cooperative agreements with the IDNR and The Nature Conservancy, burned 2,028 acres of land in FY 2012.

Figure 2-5. Typical prescribed fire intensity using hand-lighting in the foreground with aerial ignition in the background (HNF Uniontown EA)

In addition, fire can be viewed as an effective tool for enhancing the aesthetics of a natural landscape. Anderson et al. (1982) indicated that prescribed burning does not detract from scenic quality and that it may do the opposite, substantially increasing it for five or more years. When incorporated with unburned areas or islands, prescribed burning increases vegetative diversity thus attracting a wider variety of birds and other animals (Wade 1989), as well as an increase in herbaceous cover by maintaining open spaces such as barrens and vistas (Ryan 2005; Wade 1989). In Tennessee, Patey and Evans (1979) found that pine and hardwood forest managed with fire were preferred over their unmanaged counterparts. Similar results were discovered by Ribe (1990) when oak savannas maintained by prescribed fire ranked the highest in scenic ratings.

Prescribed fire is not just a tool for habitat restoration. It is also commonly used in mitigating hazardous fuels in the WUI. Methods to reduce structure losses are focused on fuel treatments in either wildland fuels or residential fuels. Because fuel build-up is less commonly a problem here than in the drier West, managers have been slower to look into the prescribed burn approach. Recent studies in hardwood forests found the near 100 percent consumption of leaf litter and 1-hour fuels eliminates surface fuel continuity immediately (Kolaks 2004) and a major contributor to fire behavior (Brown and Davis 1973; Anderson and Brown 1987).

Catastrophic fires do occur in the East. The potential for explosive and devastating fires is evidenced by legacy fire events, such as the Peshtigo (WI) and Hinckley (MN) fires, and the escape of the Mack Lake (MI) prescribed burn that was designed to restore Kirtland's warbler habitat (USFS Five Year Strategy). The Hoosier National Forest has even seen some significant fires in its recent past. Two fires, the Dutch Ridge fire in 1952 and the Georgia fire in 1964, occurred during years of above average drought. Both these fires burned more than 2,000 acres and were significant challenges not only to the Forest Service, which lacked adequate resources to suppress the fires, but also to the local communities which were affected (HNF History). From 2002 through 2012 a total of 290 fires occurred in the HNF, burning approximately 1,044 acres (NIFC).

The HNF fire management guidelines dictate the suppression of all wildfires on Forest Service land and the reduction of wildfire risk to communities, municipal water supplies, and at-risk Federal land (HNF LRMP 2006). In the public/private landscape that makes up the greater HNF area, typically 10-30 small wildfires burn during a given year, the vast majority of which occur on private land and are anthropogenic in origin. They range from uncontained structure and agricultural fires to arson (Figure 2-6). Debris-burning, a practice commonly used to dispose of trash and debris from land clearing, is the likely cause of most fire starts. Because of the highly settled nature of much of the greater HNF area, these human caused fires immediately place homes and property at risk, no matter the size of the fire. In addition, a high number of incidental roads and lack of awareness (or disregard) of property boundaries increase the likelihood that fires that start on private property will carry over to public land. Preventing human caused fires in the greater HNF area would greatly reduce the overall fire occurrence and need to respond to wildfires resulting in reduced risk to firefighters.

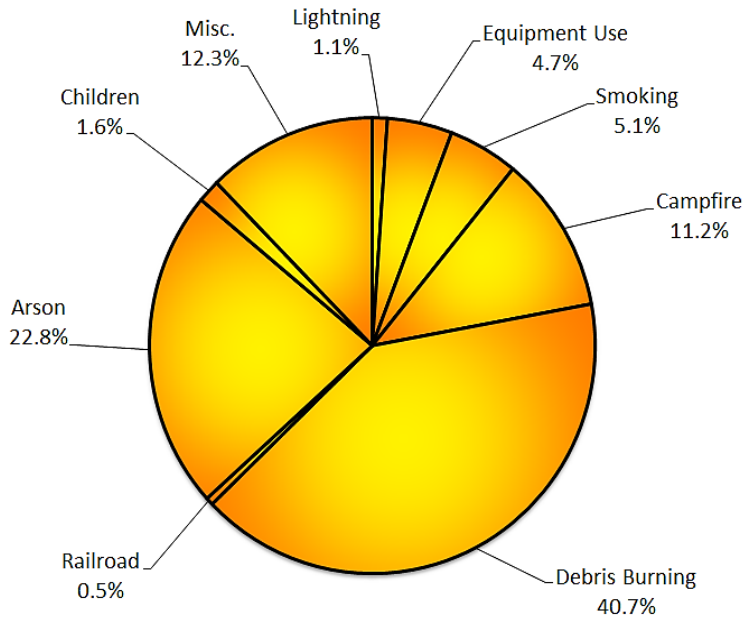


Figure 2-6. Causes of wildfire in the greater HNF area (HNF fire data, 1978-2011)

The HNF is a patchwork of jurisdictions and ownership, and often more than one agency may be involved in the management of wildland fire. Today there are 98 rural and municipal fire departments within the greater HNF area. These local fire departments, both professional and volunteer, are key partners and are often the first and sole responders on wildland fires throughout the area. Wildfire preparedness at the local fire department level can be overshadowed or downplayed because of the responsibility for more frequent all-hazard and medical emergency response. There is concern for public safety related to wildfires, including evacuations, protecting property, and post fire trauma or distress (Mangan 2007). This concern includes the need to improve and maintain infrastructure that affect wildfire response. Other related areas where inadequate planning contributes to wildfire risks are failing to ensure there is sufficient access for emergency response equipment, especially in rural areas. Maintaining or increasing the capacity of local fire departments to respond to wildfires is vital to augment state and federal response needs. This research will help not only the Forest Service and it's planning for wildfire mitigation but should be valuable to the citizens, the local county government, and emergency managers to plan and prepare for any wildland fire incidents.

Section 2.4 Social Dynamics of the WUI

Wildland fires are a social as well as an ecological disturbance with potentially far-reaching impacts to surrounding communities (Cohn et al. 2006; Downing et al. 2008; Rodriguez-Mendez et al. 2003). Some of those impacts can be tangible, such as damaged or destroyed homes and infrastructure, while many other effects may be less obvious, but no less important, ranging from the stress of evacuation and potential property loss to emotional and psychological effects from changes to the immediate landscape (Toman et al. 2012). Social science research in regards to wildfire and prescribed fire can be traced back to as recently as the 1970s when the Forest Service began to implement natural fire use and prescribed fire on many wilderness areas in the American West. Since the advent of the Joint Fire Science Program in 1998, much work has been conducted in wildfire social science in the upper Midwest (Cardille et al. 2001; Shindler et al. 2009; Sturtevant et al. 2009; Winter and Fried 2000) however; the social implications for the WUI in Indiana remain unstudied.

The WUI policies addressed in the 2003 HFRA requires public support for management strategies to be implemented successfully. Support or opposition for wildfire management can vary by sociodemographics (e.g. age, education), situational characteristics (e.g., proximity to a forest and local context) and psychological variables (e.g., beliefs and attitudes toward a management action or the managing agency) (Absher and Vaske 2007). Exurban shifts in population density, demographic, and landscape characteristics alone make it challenging for wildfire and natural resource professionals to address risk mitigation strategies among WUI residents (Gordon et al. 2013). Wildfire suppression and mitigation have even been observed as a source of conflict in communities (Carroll et al. 2006), as a "risk subsidy" for landowners who live in the WUI (Busby and Albers 2010), or even as fundamentally uncontrollable amongst community members (Winter and Fried 2000). Research into community dynamics has shown that some communities have greater capacities for the mobilization of collective resources before, during, and after disturbance events such as wildfire (Luloff and Swanson 1995; Flint and Luloff 2007). Likewise, residents' collective interpretations of the changing sociocultural, sociodemographic, and biophysical landscape can act to inform and interfere with public understanding of wildfire related risks. There exists a critical need for recognition of fire's ecological importance, sharing

of fire information, and understanding fire as a management tool. Further, there are deficiencies in the literature addressing the public's evolving perception of wildfire and prescribed fire as communities change (Gordon. et al. 2013).

The WUI represents a mosaic of people, ranging from families who have owned land for generations to individuals who spend only a few weeks a year visiting a vacation home. Likewise, those communities and landscapes change over time. Better characterizing the social context that can influence wildfire preparation or response needs to draw lessons from the large body of existing wildfire social science. The challenge with this research is not in reconciling the perspective differences in methodology, but integrating disparate studies into an emerging and cohesive understanding as it relates to a community's adaptive capacity to wildfire. Social science research has focused primarily on: 1) community/homeowner mitigation, 2) public acceptance of fuels treatments on public lands, 3) homeowner behaviors during fire and perceptions of fire management practices, 4) postfire response and recovery, and 5) wildland fire policy and planning (Toman et al. 2013). Much of this research has focused on one or a few variables that may affect individual or collective actions; in particular people's perceptions of risk and wildfire and fuels management. Fewer research efforts have attempted to understand how various social influences, local history and culture, or regional setting collectively form the social context that influences planning or local wildfire response across cases (Luloffet al. 2007; Gordon et al. 2013). Adaptive capacity in particular is primarily measured at the community level, and thus many quantitative methods such as surveys (which measure individuals) struggle to adequately capture this key aspect of social science research in the WUI. Because there is such a tremendous amount of literature on social aspects of wildfire and prescribed fire, we will break down the rest of this section into research findings that measure WUI residents at the community level (in particular adaptive capacity) and individually as it pertains to the HNF's unique situation.

The costs associated with putting out wildfires have soared, surpassing $1 billion every year since 2000 (Cleetus and Mulik 2014). Data from Montana show that, not only were there 50 percent more fires—and more human-caused fires—in WUI areas than in non-WUI areas, but the cost of suppressing any individual WUI wildfire was also 46 percent higher than for non-WUI fires (Montana DNRC 2007). Because of the tremendous costs associated with suppression and protecting WUI structures, federal

agencies have identified a significant and emerging policy objective in the form of fire adapted communities (FACC 2013; WFEC 2013; NCS 2014). This nascent concept holds that, with proper community-wide preparation, human populations and infrastructure can withstand the impacts of a wildland fire, reducing loss of life and property (Paveglio et al. 2009; Newman et al. 2013). The adaptive capacity of a community is generalized by interactional and organizational capacities, professional knowledge and extra-local networks, and local knowledge, resources, and skills; all of which any community could exhibit to some degree (Newman et al. 2013). Adaptive capacity for wildfire is not dictated by any one aspect in this framework (Figure 2-7). Rather, it "emerges" from the interaction between locals and with their local environment, which shape people and the locality they live in or care about (Paveglio et al. 2010, 2012, and 2015). While resilience often focuses on returning a community to some prior state following a disturbance, adaptation focuses on moving a community on to something new: living with the possibility of fire as an everyday fact of life, maybe even as a benefit. The achievement of fire adapted communities will be improved by understanding how social elements of adaptive capacity for wildfire interact with structural conditions at the local level.

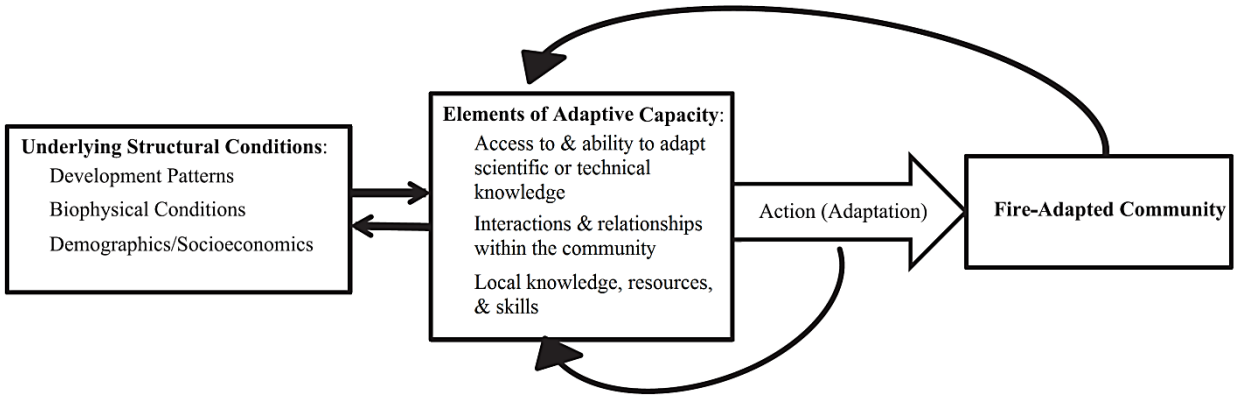


Figure 2-7. Relationship of structure, adaptive capacity, & fire-adapted communities (adapted from Newman et al. 2013)

The need to adapt policies, programs and communication strategies to the unique characteristics of people and places is long recognized (Linder 1989; Schnider and Ingram 1990; Howlett 2011). Yet, wildfire research has largely failed to comprehend how to segment diverse populations at risk except by using methods that are resource intensive, such as qualitative case studies (Carroll et al. 2004; Fischer et

al. 2012). Recently Paveglio and others have attempted to reconcile the vast social science knowledge base using an interactional approach to adaptive capacity. Their analysis revealed four consistent community typologies that differ in terms of the local social context and community characteristics that continue to influence response to wildfire risk (Figure 2-8). They are: (1) formalized suburban communities; (2) high amenity, high resource communities; (3) rural lifestyle communities; and (4) working landscape/resource dependent communities.

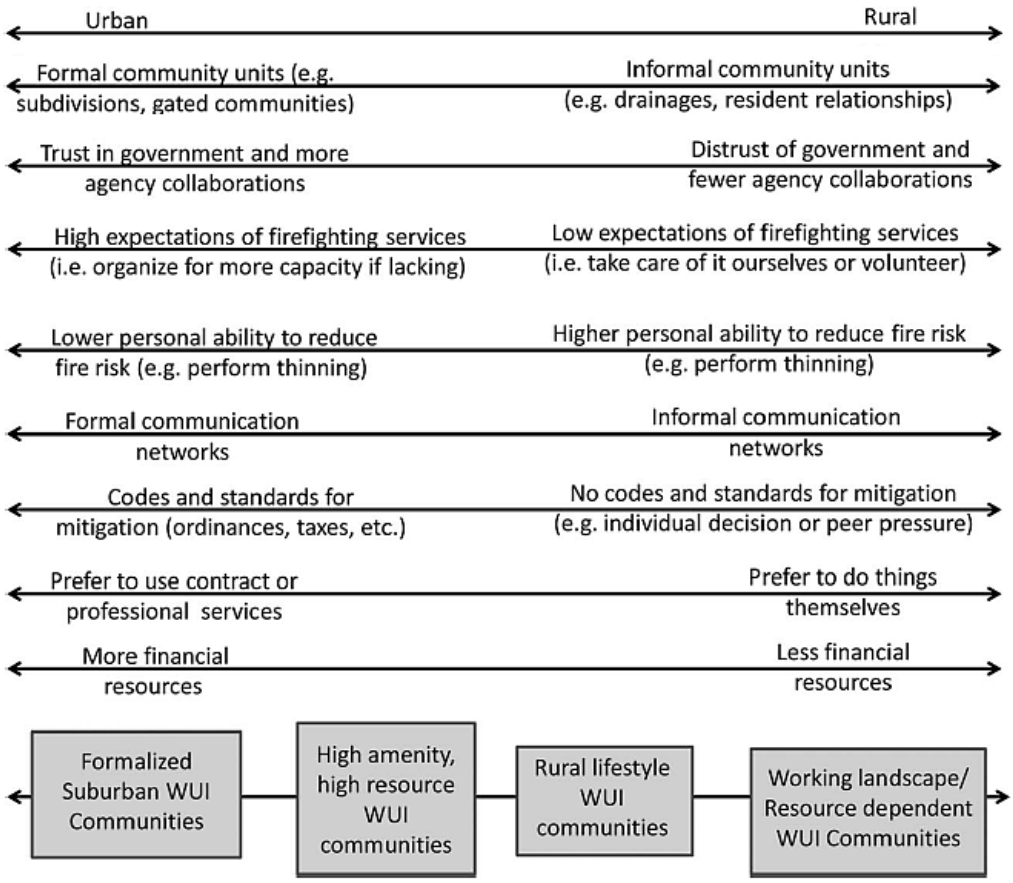


Figure 2-8. Continuums characterizing differences in adaptive capacity characteristics among WUI archetypes (Paveglio et al. 2015)

The four WUI archetypes represent communities across broad continua of mainly suburban to rural community types with differing levels of exurban communities in between. Differences among community archetypes include local communication networks, reasons for place attachment or community identity, distrust of government, and actions undertaken to address issues of forest health and

aesthetics (Paveglio et al 2015). While they mainly bear applicability to Western states (where the majority of research has mainly been focused) Eastern states exhibit some of these characteristics as well, although it can be said that some WUI residents in Eastern states live in these areas for different reasons than their Western counterparts (see Section 2.2). Nonetheless, the WUI archetypes defined by Paveglio et al. are important considerations for our social science research, and will be revisited in the conclusion of this thesis.

The realization of a fire adapted community is a policy framework in the HFRA known as a community wildfire protection plan (CWPP). Developed to integrate state and local planning with federal agencies, CWPPs can take a variety of forms, based on the needs of those involved in their development. They range from simple to complex but at a minimum a CWPP requires: (1) collaboration between local and state government representatives, in consultation with federal agencies and other interested parties, (2) prioritized fuel reduction with recommended types of treatment, and (3) recommended measures that homeowners and communities can take to reduce fire risk. The end result is federal financial assistance for community projects on both Federal and non-Federal lands and the development of strong relationships between stakeholders (agencies, industry, local groups, and homeowners). As of now, state and local governments in the greater HNF area have no CWPPs or any other collaborative framework for dealing with wildfire.

Because of its extensive road network and flat to gradual terrain, it is unlikely a wildfire the magnitude of the Dutch Ridge or Georgia fire (see Section 2.3) could occur again in southern Indiana. The Forest Service was in its infancy in Indiana during those wildfires; today the Forest has significantly more robust capabilities thanks largely in part to national resources for wildfire suppression. Because of this, it would be unrealistic to prepare for a large scale evacuation the likes of which are becoming all too common in Western “megafires”. However, small wildfires do occur across a large area in south central Indiana, nearly all of them caused by people (see Section 2.3). Because of the highly settled nature of much of the greater HNF area, these human caused fires immediately place homes and property at risk, no matter the size of the fire. Preventing human caused fires in the greater HNF area would greatly reduce the overall fire occurrence; however prevention is a difficult target to accomplish without public education and awareness. Likewise, there is an inherent instability in resource policies that do not

adequately integrate citizens' concerns (Cortner et al. 1998; Shindler et al. 2002). Within this context it is important to consider community/homeowner mitigation behaviors as well as the public acceptance of fuels treatments on public land and the interactions between the state and federal agencies and forest communities.

Some key values, beliefs, and attitudes concerning individual behavior in the WUI have been studied extensively. While the majority of research has occurred in the nations Western states, there is a strong indication that key social dynamics do not differ substantially across regions. Social science studies that included multiple study sites often found that there were more similarities than differences between sites (Toman et al. 2013) and residing closer to Forest Service lands also does not appreciably change WUI residents' attitudes concerning wildfire management (Vining and Merrick 2008). Much work has been done in the upper Midwest and Southeast, but the central hardwoods (and Indiana) region remains largely unstudied.

Table 2-3. Factors that Influence Adoption of Risk Mitigation Activities (Toman et. al 2013)

Personal/Psychological Factors	Situational Factors
Trade-offs with other values (e.g., privacy, aesthetics, naturalness, shading)	Local ecological conditions
Perceived risk and effectiveness of mitigation options	Residency status (i.e., full-time or part-time)
Social norms – perceptions of others' attitudes towards treatment options	Condition of adjacent properties
Ability to complete the risk reduction behaviors	

The concept of the home ignition zone was developed by USDA Forest Service in the late 1990s, following experimental research into how homes ignite due to the effects of radiant heat (Cohen and Saveland 1997; Cohen 2000). Subsequent Firewise[1] wildfire safety recommendations have been directed by this research and because of it, are able to provide actionable guidance for homeowners to help them prepare their property to withstand wildfire by creating defensible space. Defensible space essentially seeks to reduce flammable fuels within a structure's 200 foot ignition zone, by limiting vegetation density

[1] Firewise is a community outreach project of the National Fire Protection Association http://www.firewise.org/

in close proximity to the structure and increasing the moisture content of remaining vegetation (Table 2-4). It has been proven to be the most effective mitigation technique at reducing losses in the WUI.

Studies in several areas suggest that residents generally understand that living in the WUI brings with it increased risks of fire and most report taking some action to reduce that risk (Absher and Vaske 2006; Brenkert-Smith et al. 2006; Cohn et al. 2008; Cvetkovich and Winter 2008; Gordon et al. 2010; Jarrett et al. 2009; Kent et al. 2003; Kyle et al. 2010; Martin et al. 2009; McCaffrey 2008; Nelson et al. 2005; Ryan 2010; Weisshaupt et al. 2007; Winter and Cvetkovich 2010; Winter et al. 2009). Both formal and informal social interactions are associated with perceived risk (Brenkert-Smith et al. 2012); however social pressures and risk externalities have a greater impact on an individual's behavior than outreach programs like Firewise. Homeowners' decisions about how much defensible space to create depend on their neighbors' decisions, and generally households have more defensible space when their neighbors have more (Shafran 2004, Brenkert-Smith 2010). Likewise research has shown that homeowner's perceptions of risk are higher when vegetation on neighboring properties is perceived to be dense, thus constituting a fuel risk (Brenkert-Smith et al. 2012). Several studies also found that residents balance risk reduction behaviors with other values they hold for their properties. Small private landowners who hold the majority of forested land in some regions, such as the Eastern United States, are often more concerned about aesthetics and privacy rather than economic gain (Brenkert-Smith 2006; Nelson et al. 2004; Jones 1995; Ryan et al. 2002). This also is true for landowners, such as farmers who own woodlots and windbreaks in the Midwestern United States (Erickson et al. 2002, Ryan et al. 2002). Risk reduction activities are typically balanced to accommodate these other values, even if the risk reduction is considered sub-optimal (Table 2-3).

Awareness of risk does not automatically lead to adoption of risk reduction behaviors however. Unsurprisingly actions taken by WUI residents to avoid risk were often the ones with lower initial cost; in terms of expense or time and effort required (Brenkert-Smith et al. 2006; Bright and Burtz 2006; Schulte and Miller 2010). Many times clearing defensible space around their residences was considered part of their normal chores around the home site to maintain a home and/or property's appearance (Bright and Burtz 2006). Local ecological conditions are a consideration for many residents who have indicated a greater likelihood of adopting treatments they view as appropriate to the local ecological context (Carroll

et al. 2004, Cohn et al. 2008, Nelson et al. 2005). Residency status (whether residents were part-time or full-time residents) also may influence treatment adoption. Absentee landowners who never or rarely visited their properties were more likely to be disconnected from the local situation and take few fire preparedness actions (Brenkert-Smith 2010, Collins and Bolin 2009). When asked to indicate who is responsible for implementing protection behaviors, most residents view mitigating fire risk on their property as their own responsibility (Brenkert-Smith et al. 2006, Cohn et al. 2008, Kent et al. 2003, Martin et al. 2009, Vining and Merrick 2008, Winter and Fried 2000), yet the costs of suppressing fires in the WUI suggest otherwise.

Table 2-4. Examples of Common Actions Taken by Homeowners to Reduce their Fire Risk (Toman et. al 2013)

Access	Structure	Vegetation
Improving visibility of home address	Installing a fire-resistant roof	Removing dead vegetation and debris
Widening driveway for emergency vehicles	Using fire-resistant building materials	Maintaining low vegetation near home
	Cleaning roofs and gutters	Maintaining irrigated green area
	Stacking wood 30ft from house	Planting fire resistant shrubs
	Installing additional water supply	Spacing plants 15ft apart
	Installing screens under decks and over vents	Pruning low branches of trees within 30ft of home
		Reducting density of trees within 100ft of home
		Removing branches within 10ft of roof

Substantial research has examined public acceptance of prescribed fire and mechanized thinning as well as the trust in agencies which perform them. While prescribed fire is used in the greater HNF area as a tool for habitat reconstruction (see Section 2.3), it is also commonly used in a Western context in mitigating hazardous fuels in the WUI. Because fuel build-up is less commonly a problem here than in the drier West, managers have been slower to look into the prescribed burn approach as a fuel reduction

technique in the WUI. Nonetheless, its use is extensive in south central Indiana in some years, and because land managers are attempting to implement prescribed burns to reintroduce fire adapted plant communities across the landscape, homeowners and visitors to the WUI themselves may need to adapt to its impacts. We will revisit many of these concepts described below at the conclusion of this thesis.

Within the context of wildfire risk, studies in a variety of locations have found high levels of acceptance (more than 80 percent in many at-risk communities) of some use of both prescribed fire and mechanized thinning treatments to reduce fuels (Absher and Vaske 2006; Brunson 2008; Lim et al. 2009; McCaffrey 2006; McCaffrey et al. 2008; Toman and Shindler 2006; Vogt et al. 2007). Opinions vary greatly however when prescribed fire is used primarily for ecological benefits. Throughout the US there are variations in the public's willingness to accept smoke, visual impacts, and increased short term risks associated with prescribed burning (Weber and Taylor 1992; McCaffery 2006). The disparity in the type of land ownership and differences in the legal, political, and cultural environments affect the attitudes of fire managers and communities in these fire-prone regions (McCaffrey 2006; Quinn-Davidson and Varner 2012). Smoke, concerns about escape, and agency trust are key issues shaping support for prescribed fire use.

Table 2-5. Factors Contributing to Negative Landowner Perceptions of Prescribed Fire (Busam and Evans 2015)

Physical	Personal	Health and Safety
Aesthetics	Property damage from escaped fire	Safety and health concerns
Erosion	Viewed as destructive and dangerous	Smoke and air quality concerns
Proximity to residences	Financial concerns	
Perceived damage to wildlife and habitat	Liability concerns	
Preference for mechanical fuels treatment	Lack of experience	
	Personal experience w/ wildfire	

While prescribed burning can mimic natural disturbance, like a wildfire it can leave a forest understory blackened, a detriment to beauty can be perceived negatively by the public (Gobster 1999;

Scott 1998; Taylor and Daniel 1984). Another detractor from aesthetic beauty that can also pose a health hazard to sensitive populations is the smoke generated from a prescribed burn (Blanchard 2003; McCaffrey 2002; Shindler et al. 1996; Winter et al. 2005). In the past, smoke from prescribed burning was managed primarily to avoid nuisance conditions or traffic hazards. While these objectives are still valid, smoke management programs today are also likely to be driven by local, regional, and federal air quality standards. The HNF itself is all too aware of this issue as evidenced in recent environmental assessments in its various management areas. Emissions from smoke modeled in a first order effects model (FOEM) found EPA criteria pollutants of significant concern; PM 2.5, PM 10, and CO (NWCG 2003), persist immediately after and during a burn. This suggested that prescribed burning would impact the air quality of the immediate area (HNF Uniontown EA 2011). Given the highly settled nature of the greater HNF area this means it is unlikely that any prescribed burn conducted will not put smoke on someone's residence somewhere. In general, people in the WUI appear to understand that no smoke is an unrealistic option: they will be exposed to smoke, either from a wildfire or from a prescribed burn, and so long-term trade-offs will need to be made. One way to manage the health issues is to provide adequate warning of a prescribed burn, to allow those with health issues to make arrangements. Additionally topographic considerations need to be considered, as people who live in valleys prone to air inversions may be adversely affected.

Prescribed burning can be negatively affected by rare mistakes or unexpected events that can overwhelm understanding of their ecological and economic benefits. Over 99% of prescribed fires are successfully and uneventfully held within planned perimeters (Dether and Black 2006). But when burns escape, the consequences for future use of prescribed fire can be huge. The escape of the Mack Lake prescribed burn in 1980 that was designed to restore Kirtland's warbler habitat in Michigan is an example of when good intentions can go incredibly wrong. Originally implemented to treat just 210 acres, high winds and low fine-fuel moistures created a wildfire that was 25,000 acres in size, destroying 44 homes and killing one firefighter (Borie 1981). Escaped fires like Mack Lake can fuel public fear and increase distrust regarding prescribed burning. Media coverage of wildland fire events also contributes greatly to public perceptions. Catastrophic wildfire events and conflicts between homeowner's private property and

public land managers grab headlines (Johnson et al 2006; Mercer and Prisbrey 2004), while numerous small successful prescribed burns get little attention if any.

Though not universal, residents in the WUI qualify fuels treatments within the context of where the treatment is to be conducted. WUI residents typically prefer the use of mechanical thinning near developments and the use of prescribed fire in more remote locations (Bright and Newman 2006; Brunson and Shindler 2004; McCaffrey 2013; Ryan et al. 2006). Two variables in particular were consistently associated with higher acceptance across sites: familiarity with a treatment technique and trust in those implementing the treatment (McCaffrey 2013, Toman et al. 2014; Shindler et al. 2009, Winter et al. 2004). Trust is perhaps the most important variable as to whether or not prescribed fire use is continued in a WUI community. It has been conceptualized in different ways; common definitions describe trust as perceived competency of agency managers to implement treatments, perceptions of shared values between public participants and agency managers, or a combination of these two approaches (Brunson and Evans 2005; Winter and Cvetkovich 2008; Winter et al. 2004). Toman et al. (2011) found confidence in agency managers to effectively implement specific treatments (perceived competency) had the strongest influence on treatment acceptance, even when accounting for other variables (e.g., residency status, ratings of agency management, and general trust in agency managers). Understanding the ecological benefits of prescribed burning appears to be particularly important in shaping approval (Carpenter et al. 1986; Winter et al. 2005). Knowledge of ecological benefits can also make smoke less of a concern (Shindler et al. 1996; Weisshaupt et al.2005). Findings suggest that outreach programs can have a positive influence on knowledge and, in some cases, on attitudes toward treatments (Deau and Vogt 2004; Knotek and Watson 2006; Loomis et al. 2001; McCaffrey 2004; Parkinson et al. 2003; Toman and Shindler 2006; Weisshaupt et al. 2005).

Chapter 3 Methods

The broader thesis research will address two key areas: 1) modeling a realistic WUI geospatial layer using ancillary data for the HNF; 2) using the refined WUI layer as a tool to target a random sample mail survey. We have structured this methods section to reflect the research work that has been done chronologically since 2013.

Section 3.1 WUI GIS Development

Defining the WUI consistently and clearly is an important task. Delineation of the WUI in the United States has relied principally on policy-specific criteria applied to a GIS. Maps of the WUI are important for resource management, particularly related to wildfire mitigation, but are often based on spatially coarse data such as housing counts from census blocks. Although the spatial extent of the WUI is clearly important to fire policy, there is no commonly accepted definition of the WUI. Federal policy, such as the Healthy Forests Restoration Act (HFRA), is vague about what constitutes the WUI (Hill 2001). Thus, exactly what establishes an "at-risk" settlement or an appropriate area surrounding a settlement is not standardized (Wilmer and Aplet 2005; Platt 2006).

Advances in remote sensing and spatial analysis have increased the rate of change in WUI mapping and analysis by expanding the data and methods available. The resulting maps of the WUI have been used for many purposes, including evaluating the potential for home construction next to public forests (Gude et al. 2008), estimating the area and number of housing units within fire regime condition classes (Hammer et al. 2007), estimating the extent of the WUI within fire hazard classes (Theobald and Romme 2007), and developing scenarios for future expansion of the WUI (Platt 2006; Thomas and Butry 2014). While differing in intent, all these definitions have three common components: housing or settlements, a buffer around the settlements, and wildland vegetation (Platt 2010).

Current WUI GIS data are designed to provide a national assessment across the conterminous United States (Radeloff et al. 2005). However, no single mapping approach is unequivocally superior, and because of the national scope of this data, application to WUI problems on a smaller local scale becomes more difficult, especially in the heavily populated East. Arguments for a variety of WUI mapping

methods are compelling, but some degree of consistency and replicability is necessary to support policy making that affects the distribution of resources. Given that federal programs target treatments or community outreach within the WUI, any differences could affect the areas prioritized for treatment and how funds are allocated.

The location of a structure, and its arrangement relative to other structures or wildland fuel, is of key interest in preventing wildfire-related losses in the WUI (Cohen 2000; Frontiera and Kearns 2007; Murname 2006). Housing data are however, a major problem for WUI mapping. When housing data are zonal i.e. polygons, the concept of a WUI neighborhood can be captured easily in a density measure, but variations in zone (census block) size and shape introduce bias as to where the risk for human structures actually are. Alternatives to zonal methods of WUI mapping utilize actual locations of homes or structures. Such structure- or point-based methods use the spatial coordinates for each individual structure. Such WUI maps have been developed in several European countries where wildland fire management and policy vary over smaller spatial scales (Silva et al., 2010; Lampin-Maillet et al., 2009, 2010).

The average population density of the counties contained in the HNF purchase boundary is 98 persons per square mile, which is high compared to other areas that experience wildfire risk (e.g. western states). The majority of the land surrounding the HNF is considered “interface” according to the HFRA and Federal Register definitions using population density rather than proximity to a specific “community”. Methods that work well for Western situations are inaccurate and confusing to decision makers and natural resource managers and do not translate well for working in highly settled areas like the Hoosier (Kolaks, personal communication). Since these established references are not very applicable or representative of the urban interface setting in the HNF, the Forest required new ways of mapping the WUI which reflected the complexity of the private/public landscape.

The issues most concerning fire management specialists in the HNF are how to differentiate what areas of the Forest should be considered interface and which areas are intermix. To accomplish this, a structure and fuels based approach was adopted similar to point based methods described above. Work coordinated since fall of 2013 with the HNF Fuels specialist addressed the need for a higher resolution GIS dataset by using ancillary data acquired through a variety of local government resources in the nine-

county area. This method requires two types of datasets: address point data and existing vegetation cover. In the case of Indiana both these data are free and available online. The definition we used for the WUI in the HNF originated in the 2001 Federal Register (66:751, 2001) report on WUI communities at risk from fire and the HFRA. Our goal was to develop a consistent method to map the WUI that is able to determine where interface and intermix exists, using just housing location and wildland fuel data. Additionally this method does not violate any particular policy concerning the WUI in the HFRA by following the guidelines set forth in Title I sec. 101. ArcGIS 10.2 was used throughout the development of this dataset and a model with tools and inputs can be found in Figure 3-2 in Appendix B.

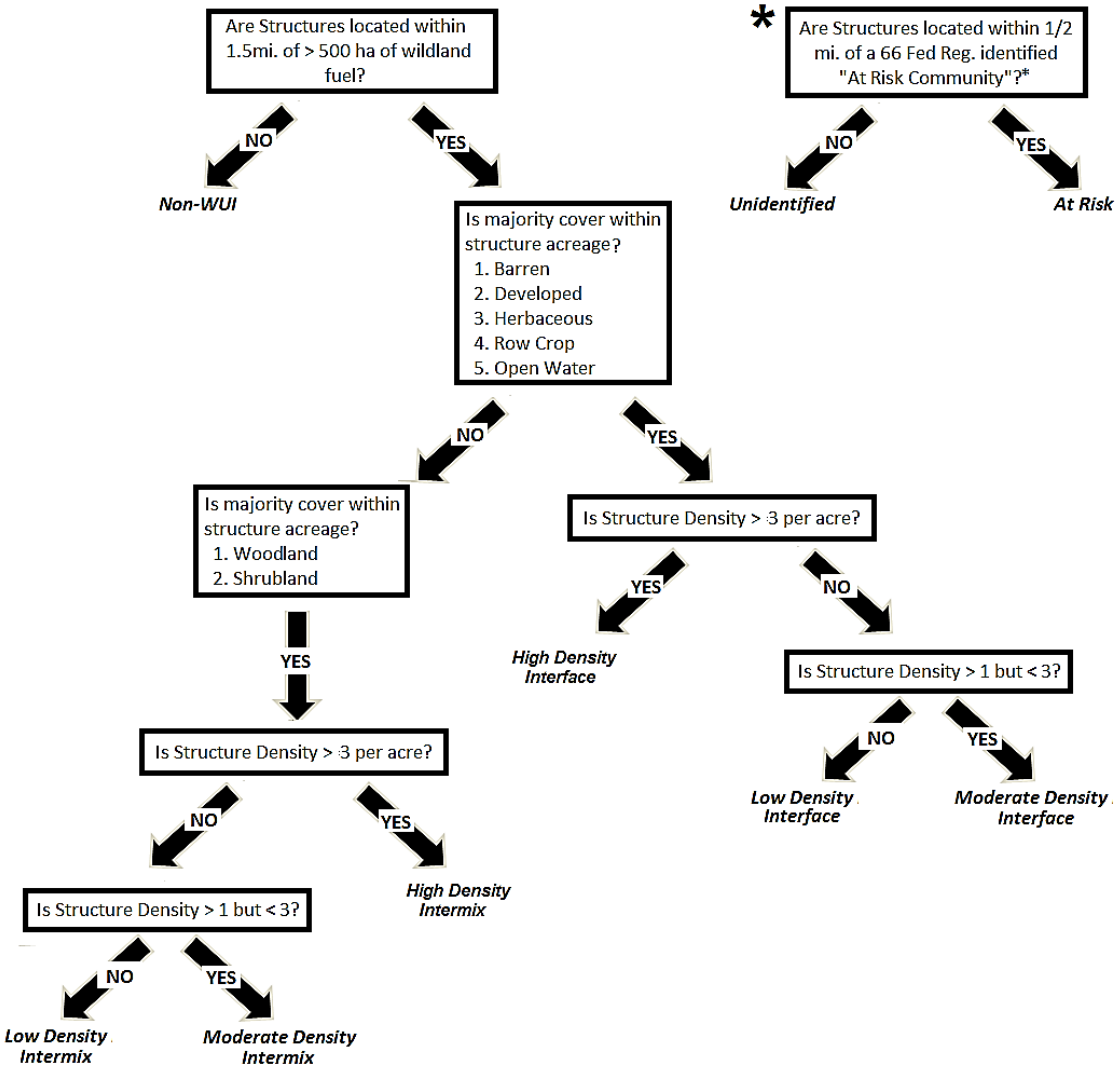


Figure 3-1. HNF WUI model definition

Structure Density: Assessing the WUI requires detailed data on housing density. According to the Federal Register definition, WUI areas must contain at least one house per 40 acres. Given the highly settled landscape of the greater HNF area, this threshold is easily reached. The point feature class that contains address points is maintained by county agencies in Indiana and is provided by personnel of Indiana Department of Homeland Security (IDHS) as part of the IndianaMap Data Sharing Initiative (http://www.indianamap.org/). Gaps or missing data in the address points were resolved by two methods: using parcel centroids generated from IndianaMap county land parcel data and digitizing structures from 2012 National Agriculture Imagery Program (NAIP) imagery. Using the address point data as de-facto structures, a structure density raster layer was created with ArcGIS 10.2 with a one acre cell size. In a GIS a point to raster conversion tool was used. The method to determine how cells were assigned a value was determined with a counting function. This raster dataset was then converted to a polygon feature class for further analysis. Structure densities per acre range from one to thirty-seven (Map 3-1). It is important to note that this structure density does not include additional structures such as outbuildings, barns, or warehouses. Additionally structure densities could be abnormally high for an acre cell if the structure within this cell is an apartment or other form of multi-family housing. This is because multiple addresses are associated with one or more structures.

Existing Vegetation Cover: In addition to housing density, the WUI assessment required fine-resolution vegetation data. We used the USGS LANDFIRE existing vegetation cover dataset for the vegetation layer (http://www.landfire.gov/). LANDFIRE data products are designed to facilitate national and regional-level strategic planning and reporting of management activities (Map 3-2). Vegetation is mapped by the USGS using predictive landscape models based on extensive field reference data, satellite imagery, biophysical gradient layers, and classification and regression trees. It is a more detailed and updated land cover dataset than the National Land Cover Dataset (NLCD) also produced by the USGS. For ease of use, we used a raster to polygon conversion tool in a GIS. The IDHS structure points feature class was intersected with this converted cover and fuels layer (1:100,000 scale). This intersection effectively assigns the cover/fuels land classification to the structure point feature class. Then, converting the points back to a raster dataset, an acre cell raster dataset was created based on the most frequent fuels type

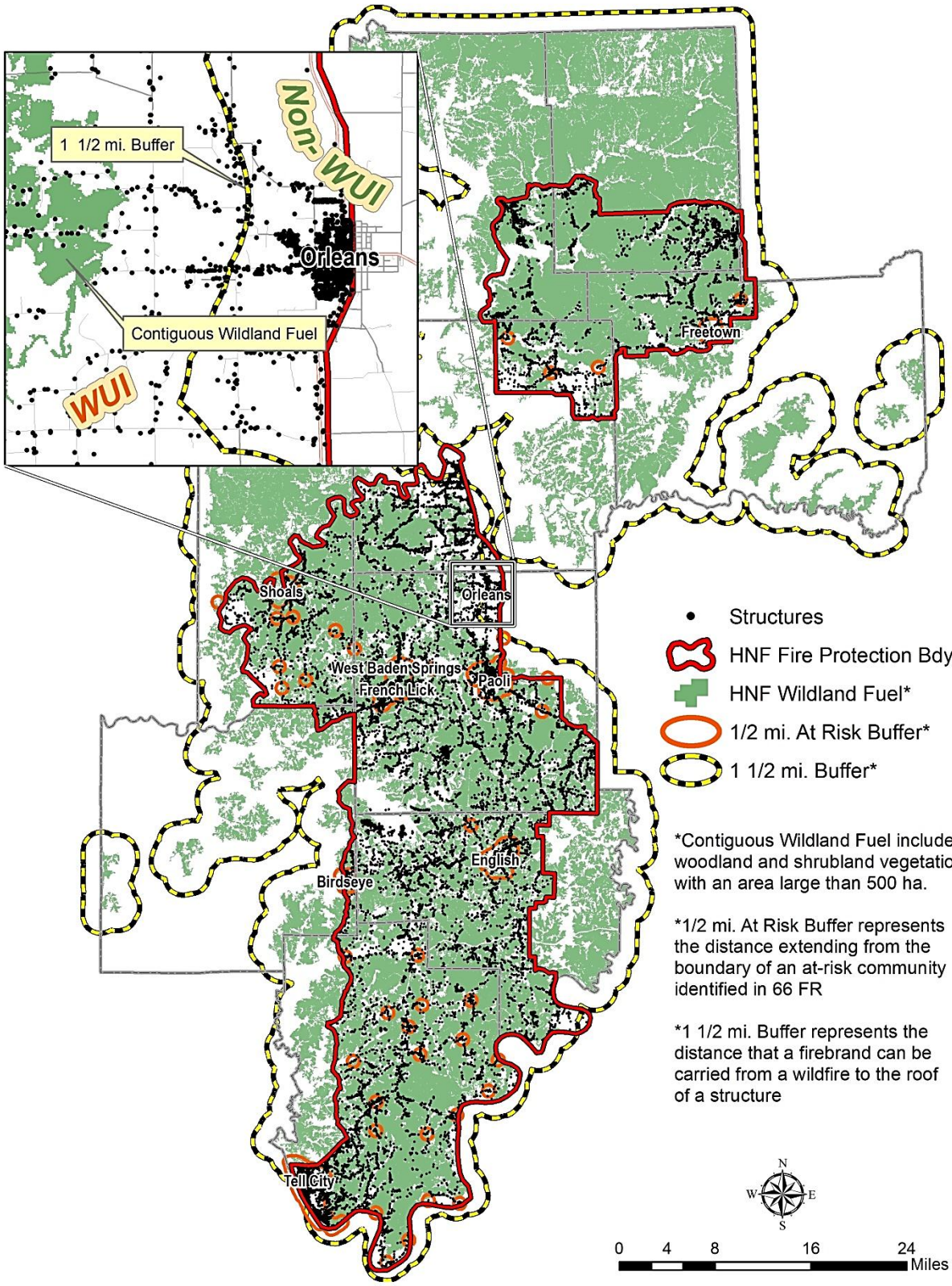
within the cell. Using this method, if there is more than one feature within the cell, the one with the most common attribute is assigned to the cell. This raster dataset was then converted back into a polygon feature class and intersected with the structure density polygon (see above). In addition the cover dataset was queried for wildland fuel (for southern Indiana this would be woodland or shrubland). Contiguous areas of vegetation greater than 500 hectares (5 km^2) were retained as a separate polygon feature class for analysis (see below).

Wildland Urban Interface: The WUI is the area where housing is in close proximity to wildland vegetation. Locating the WUI required first identifying areas with wildland vegetation and then including areas within "close proximity," represented by a buffer some distance from the vegetation. The contiguous blocks of wildland fuel were buffered 1½ miles; representing the distance that firebrands can be carried from a wildland fire to the roof of a house (Stewart et al. 2007). Structures that fell within this 1½ mile buffer were assumed to be WUI (Map 3-3). The resulting structure and cover layer was then segregated into interface if the major land cover type within that acre cell was classified as barren, developed, herbaceous, row crops, or open water. These cover classifications represent either defensible space, sparse fuels, or developed land. If the major land cover type within the cell was woodland or shrubland than the feature was classified as intermix. This was chosen because it represents structures that are in continuous wildland fuel. WUI density for each of the two categories was further defined using structure density; three or more structures per acre were high density, two structures were moderate density, and one structure was low density (Map 3-4). Further analysis of the WUI dataset is discussed in the next section.

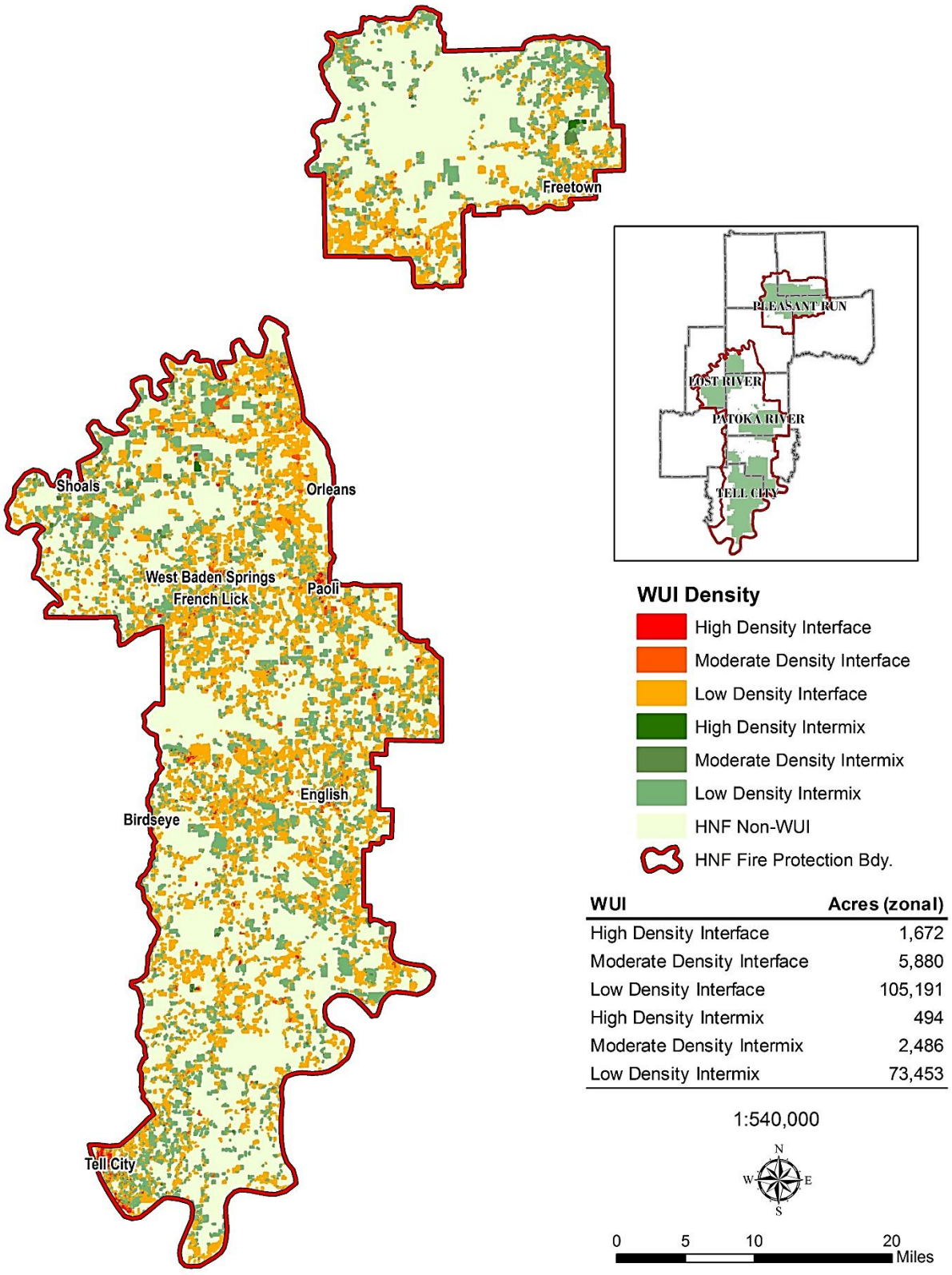
At Risk Communities: The 2001 Federal Register listed 50 at risk communities that are within the HNF's fire protection boundary. An at risk community as identified in the Federal Register, is a community in the vicinity of Federal lands at risk from wildfire. The delineated urban areas for each of these communities were used from the US Census Bureau TIGER data and point data from the USGS GNIS database. Identified at risk communities were then buffered ½ miles in accordance with the HFRA. Any structures that fell within that buffer were assumed to be at risk. All others were noted as "unidentified" (Map 3-5).

Wildland Urban Interface (Zonal): The resulting WUI dataset makes a compromise between large inaccurate spatial data and fine scale point data. One major downside to using smaller one acre cells for a WUI layer is in the large scale representation of the WUI for reproducible maps. For this reason we created a simple zonal layer by spatially joining the one acre WUI dataset with a created intersection of US Census Blocks, County land parcels, USGS LANDFIRE vegetation, and USGS NHD HUC12 watersheds. Using a spatial join (as opposed to an intersection) maintains the spatial integrity of discrete areas, while appending WUI attributes to the target feature class. The join operations used was one-to-one and were matched if they intersected a target feature. The rationale behind this was to create a layer that was more accurate at a smaller scale than simply using the US Census Blocks that are commonly used to represent WUI data. Developed feature coverages range in acreage from less than one acre to ~575 acres in size. This layer is useful for mapping data at scales above 1:100,000[2].

[2] All WUI maps in the appendices are mapped with zonal data.



Map 3-3. HNF WUI Definition.



WUI	Acres (zonal)
High Density Interface	1,672
Moderate Density Interface	5,880
Low Density Interface	105,191
High Density Intermix	494
Moderate Density Intermix	2,486
Low Density Intermix	73,453

Map 3-4. HNF WUI Density (Zonal Data).

Section 3.2 WUI GIS Analysis

A good WUI map provides a graphic representation that matches the conceptual understanding of what and where the WUI is. Current open source WUI GIS data by Radeloff et al. (2005) differentiates interface from intermix by housing density, rather than by the proportion of wildland vegetation that is contained in a census block. In both interface and intermix communities, housing must meet or exceed a minimum density of one structure per 40 acres. Because of the national scope of this data, application to WUI problems on a smaller local scale becomes more difficult, especially when delineating between interface and intermix. This problem is further compounded because most WUI maps use housing data from the US Census. The spatial extent of a census unit varies with housing density, tending toward larger units where housing is sparse. The result can be a large census block with a small cluster of homes in one area but large uninhabited spaces in the rest and an average density too low to meet the WUI criteria (Stewart et al. 2009). However, because of the highly settled rural landscape of southern Indiana this issue is largely avoided.

Previous national assessments by Radeloff et al. are available through the Wisconsin University SILVIS lab at http://silvis.forest.wisc.edu/maps/wui_main. WUI data was downloaded and clipped to the HNF Fire Protection Boundary. A comparison of French Lick Township in Orange County between our newly created WUI zonal data and the Radeloff et al. 2010 data is illustrated in Figure 3-3[3]. It is important to note that the resulting WUI maps do not indicate the risk of fire; it shows only where houses and wildland vegetation coincide. Likewise they are not exacting. The only way to evaluate whether a structure in the GIS data is explicitly interface or intermix would require a physical survey of the structure and its surrounding land.

Two immediate observations are apparent: 1) our developed WUI layer models structure proximity to fuel; not housing or vegetation density per census block, thus the analyzed acreages of interface and intermix are significantly different from Radeloff et al., and 2) there are zonal areas of the Radeloff dataset that disregard entire areas with structures that for all intents and purposes should be included in the WUI. We strongly feel this method is more accurate at describing the WUI at the local

[3] Our WUI zonal data was selected because it was more appropriate for use in the comparison to Radeloff et al. than the one acre point-based WUI dataset we developed. Throughout the rest of this section, zonal data is used to describe the WUI.

scale instead of data commonly used at a national or regional level because it classifies every structure within 1 ½ miles of wildland fuel into interface or intermix. Out of the 29,283 structures within 1 ½ miles of contiguous wildland fuel in the HNF fire protection boundary, Radeloff et al. misclassify 9,756 structures as non WUI, more than a third.

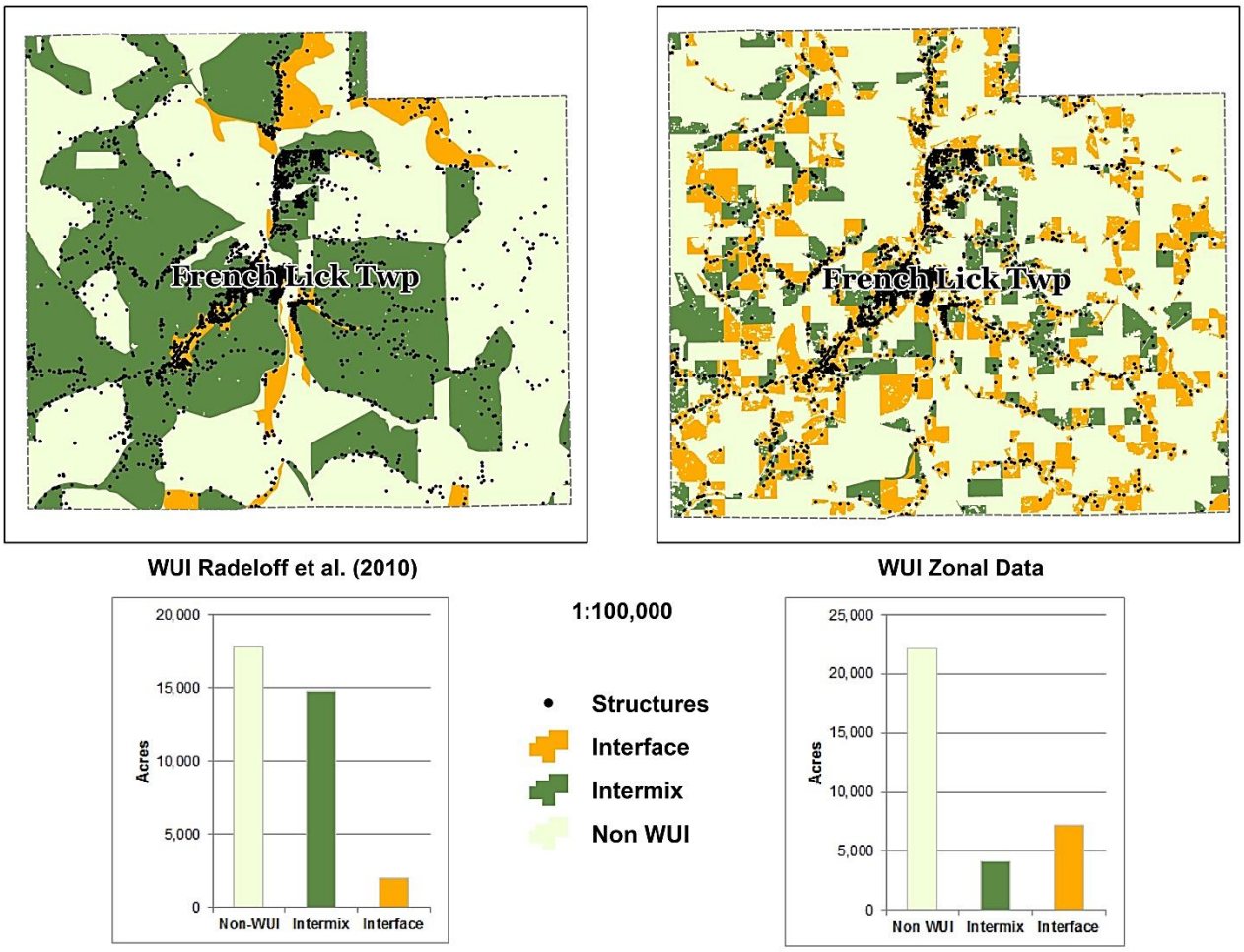


Figure 3-3. Developed WUI data compared with Radeloff et al. (2010)

As previously discussed in Chapter 2, the HNF is unique in its setting because it is not the predominant landowner within its boundaries. Because of this, WUI from parcel to parcel within the HNF can vary from interface to intermix within a small area; primarily due to proximity to large contiguous blocks of wildland fuel and land use changes impacting fuel type from parcel to parcel. We feel this method of classifying the WUI for complicated land ownership patterns is superior to Radeloff and

others, and captures the realities of the highly fragmented landscape that is the greater HNF area. An important distinction between our dataset and Radeloff and others, is that we include fuel types that are predominately ignored in other assessments. These include herbaceous cover typically associated with fallow fields or pastures; cultural vegetation associated with suburban areas or infrastructure; and agricultural row crops. Although these fuel types do not represent the large management concerns associated with wildfires, they nonetheless can burn despite being attributed in fuel models as "non-burnable" (Scott and Burgan 2005). This is especially true with row crops farmed in lower lying areas of the HNF. Many small wildfires begin from agricultural equipment overheating and becoming an ignition source for field dry corn or soybeans during harvesting operations (Kolaks, personal communication). Equipment ignitions alone account for approximately 5% of fire starts in the HNF area (see Figure 2-7).

Within the HNF fire protection boundary, 95% of all structures would be considered to be in a WUI condition, and 36% are within our at risk community buffer (Map 3-3). The WUI makes up 21.7% of the total land area of the HNF which is significant in comparison to the rest of the state. Within the HNF's fire protection boundary (1,362.5 miles^2), interface makes up 12.9% and intermix makes up 8.8% of the total land area. Across the region, interface is the most dominant form of WUI within the HNF fire protection boundary (Map 3-4). In some counties and management areas, however, intermix has a stronger influence (Figure 3-4 and 3-5).

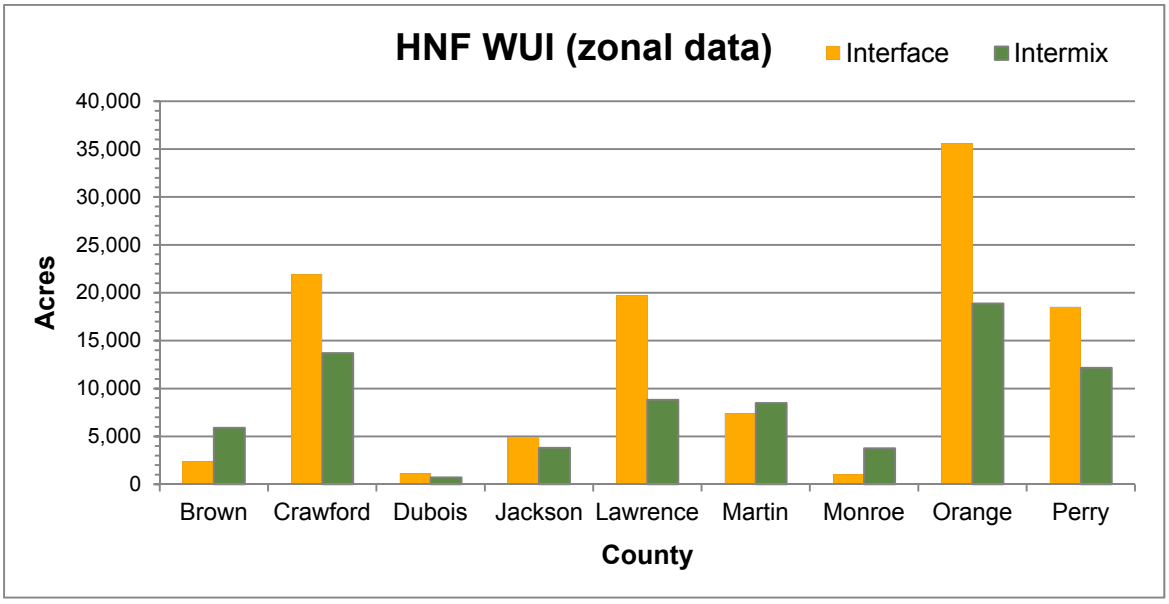


Figure 3-4. HNF WUI by county within the fire protection boundary

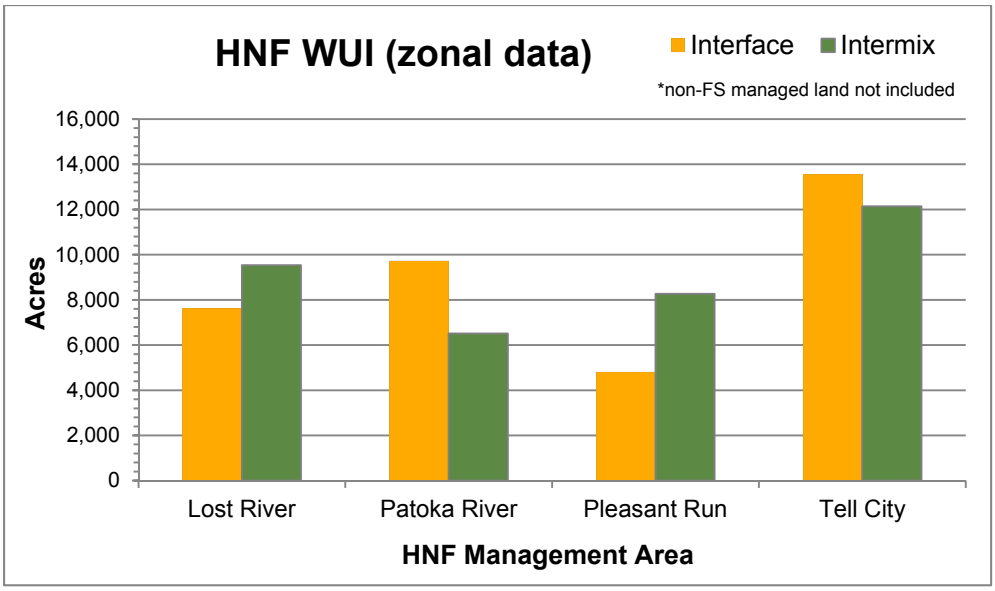


Figure 3-5. HNF WUI by FS management area within the fire protection boundary

As of September 2014, the HNF Forest staffs have received the completed GIS datasets we have developed. Having data at a Forest-scale resolution should assist them in focusing fuels treatment efforts in areas benefiting the greatest good, in the pre-planning of suppression activities, and in the initial planning phases of NEPA documents. Data set improvement is an ongoing process. Further efforts should be made by the HNF to "ground-truth" the data to further refine its accuracy and use in future planning.

Section 3.3 Survey Design

Survey research is one technique to obtain the views of the general public (Shindler et al. 1993; Vining 2004). Previous social surveys conducted by researchers from the Hardwood Ecosystem Experiment found many similarities between the recreationist and neighboring landowner groups for acceptability of forest management practices, desirability of forest scenes, and likelihood of visiting (Rogers et al. 2013). When asked what their perceptions were regarding possible threats to forests in Indiana, survey respondents regarded the risk of fire (whether planned or un-planned) to be very low (Rogers et al. 2013). However, no surveys analyzing fire issues specific to the WUI in South-Central Indiana have been conducted.

The quantitative research will use a random sample mail survey to get a better sense of residents' perceptions of risk and their attitudes toward wildfire and prescribed fire management. This work will help wildfire and natural resource professionals in the greater HNF area understand the social and physical complexities influencing the threat of wildfire on public and private land. Conducting a survey will allow for broader community input to further explore issues related to residents' perceptions of wildfire and prescribed fire.

Minimizing survey error and maximizing survey participation will assure the collection of high quality data where findings can be generalized to a broader population beyond the sample. Toward this, we used the Dillman Tailored Design approach to survey research, which is structured to minimize several types of survey error (e.g., coverage, sampling, nonresponse, and measurement error) (Dillman et al. 2009). To minimize coverage error, a random sample was chosen so that all members of the survey population (residents in the HNF WUI) have an equal chance of receiving the survey. The survey sample population was generated from GIS data from each of the nine counties identified above. Census block housing data were used to define the survey sample by intersecting the HNF management area boundaries with the 2010 census data (Map 3-6). The total number of housing units in the survey sample is 8,918; for a 95% sample confidence level our estimated returned sample size would ideally be 384 surveys for a desired precision of ± 5% margin of error (Dillman et al. 2009). This sample size assumes maximum heterogeneity (a 50/50 split) on a proportion in the population from which the sample is to be drawn.

$$\text{Sample Size} = \frac{8{,}918\ (0.5)(0.5)}{(8{,}918\text{-}1)\ \left({}^{0.05}/_{1.96}\right)^2 + (0.5)(0.5)} = 384$$

To achieve a desired response rate[4], 961 surveys were mailed to respondents. Because Dubois County's influence on the survey sample was so small, it was ultimately eliminated from the survey to conserve resources. Stratified sampling by census block housing within the fire protection boundary will be used in order to allow for statistical comparison among the counties as well as aggregating survey respondents that are in the WUI (Table 3-1). Survey distribution followed a modified Tailored Design

[4] The 40% response rate was used to control costs. The numbers for the counties were arrived at by simply dividing the original survey sample (20% response rate = 1,922) in half and discarding Dubois County from the sample.

Method, developed by Don Dillman and generally regarded as the standard for mail survey methodology (Dillman et al. 2009). This method includes sending out a questionnaire, followed by a reminder/thank you postcard, and additional replacement questionnaires to non-respondents. This survey design has strongly shown that repeated contacts in the form of preliminary notification and follow-ups, appeals, inclusion of a return postage, and monetary incentives, are effective at increasing response rates (Yammarino et al. 1991). Our second and third wave mailings will be strategically stratified, meaning we will not be surveying all non-respondents, but will be sending questionnaires to a portion of our sample who have not responded as strongly (Singh et al. 1994). Incentives (e.g. gift cards) were used in the survey to elicit a higher response rate.

Table 3-1. Survey Sampling Methodology

	Brown	Monroe	Crawford	Perry	Martin	Lawrence	Orange	Jackson	TOTAL
HNF Mgmt. Area Housing (2010)	493	472	1,420	1,743	715	998	2,263	647	8,918
± 5% Margin of Error									384
40% Response Rate									961
Weighted Mgmt. Area Housing Factor	0.06	0.05	0.16	0.20	0.08	0.11	0.25	0.07	
# Mailings/County *	48	54	145	201	94	101	242	76	961

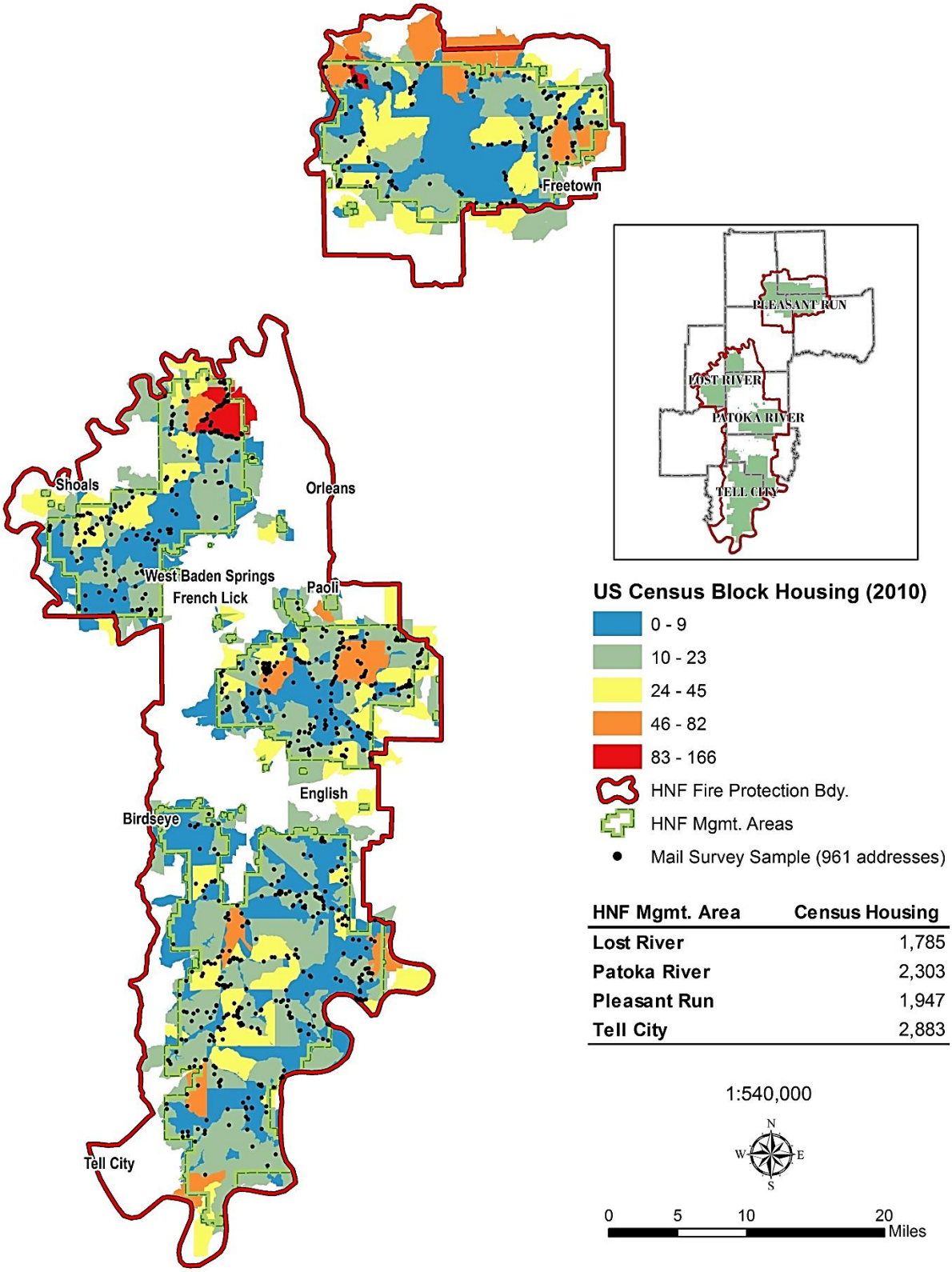
* Number of mailings/County was refined based on IDHS address database accuracy and USPS known addresses

Sampling and non-response error were minimized by encouraging the participation of sampled households. We applied the theory of social exchange to the survey process to minimize nonresponse error. This is accomplished by increasing the perceived benefits (e.g., assuring potential respondents that information they provide by filling out the survey will be useful and will help forest managers plan for and mitigate wildfire threats in their communities; by participating in the survey participants will be entered into a drawing to win one of several gift cards to a sporting goods store); decreasing the perceived costs (e.g., by reassuring potential respondents that: the information they provide is completely confidential; their names will never be used publically or in any way connected to the data they provide; they do not need to know specialized information to fill out the survey; filling out the survey will only take 15-20 minutes), and establishing trust throughout the survey process (e.g., initial contact with potential respondents will include a letter, addressed to them specifically explaining the nature of the study and how information they provide will help forest managers; the letter will contain assurances of

confidentiality and will have project PI contact information and contact information for Ball State's Office of Research Integrity should the participant have questions about their rights as a research participant[5]).

Finally, every effort was made to minimize measurement error by designing a high quality survey. That is, the questionnaire layout and the design and wording of individual questions will be simple and straightforward. To ensure a high quality survey, pre-survey testing was conducted with various individuals not included in the sample population. Test participants were solicited for their opinions concerning survey question wording, survey organization, flow of the survey, grammar, and how much time is involved in taking the survey. This test was conducted in fall 2014, and helped identify and correct survey issues before sending surveys to the actual study population. Throughout the project research, interviews and meetings were also conducted with the HNF Forest staff to ensure that agency input was incorporated into the survey design. This methodology (i.e., interviews followed by a survey) is used regularly in mixed methods studies and has a proven track record in the natural resources field in identifying salient issues concerning communities and land management/natural resource issues (Flint 2006; Creswell 1994).

[5] All survey related materials used in recruiting participants as well as the questionnaire are located in the appendices.



HNF Mgmt. Area	Census Housing
Lost River	1,785
Patoka River	2,303
Pleasant Run	1,947
Tell City	2,883

Map 3-6. Survey Sample (US Census 2010).

Chapter 4 Survey Results

Table 4-1. Survey Statistics by HNF Management Area

	Lost River	Patoka River	Pleasant Run	Tell City
Questionairres mailed	196	237	192	312
Nondeliverable*	42	54	39	55
Presumed delivered to participant	154	183	153	257
Full or partial responses	23	32	34	54
Response rate	14.9%	17.5%	22.2%	21.0%

*nondeliverable - vacant, deceased, no receptacle, not forwarded, or not a viable address

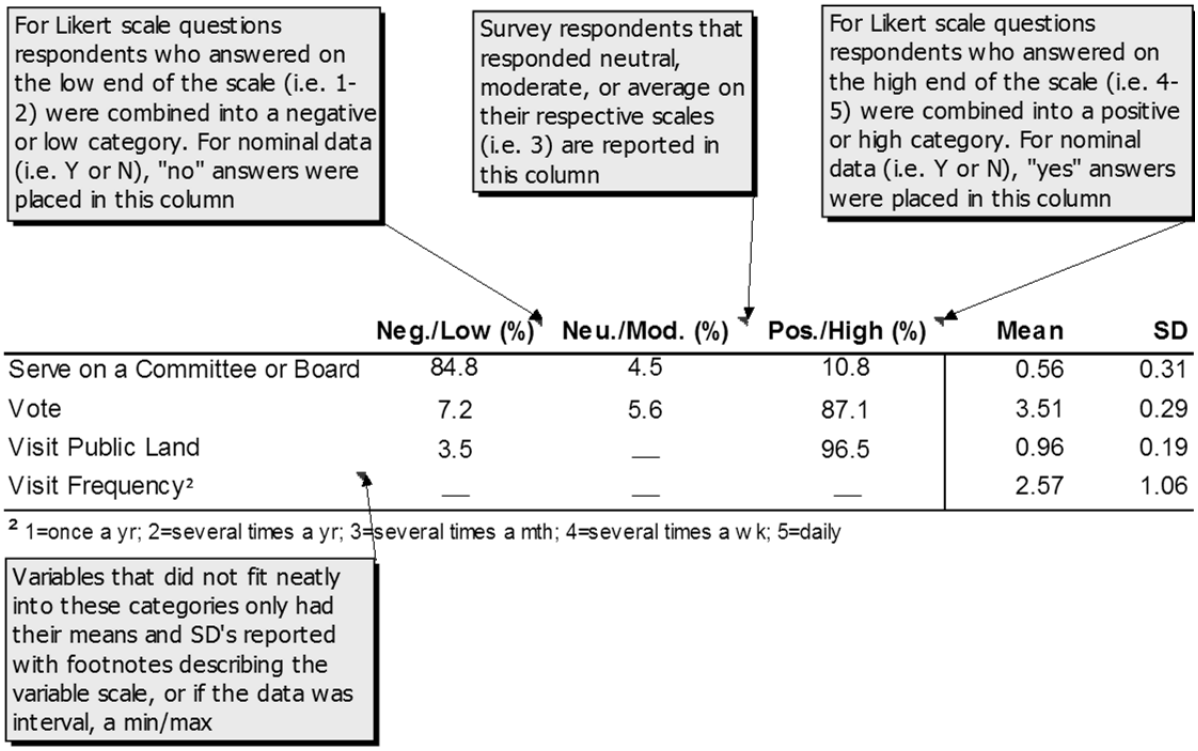
Survey distribution began early spring 2015. This was a ten week survey consisting of two mailings of questionnaires and post cards from January 26 through April 1. In total 143 questionnaires were returned with an overall response rate of 19.1% (Table 4-1). Some management areas had higher response rates (Pleasant Run at 22.2% had the highest) and some had lower response rates (Lost River with 14.9% was the lowest). We also experienced a high percentage of nondeliverable questionnaires (20.3%). Data from the returned structured questionnaires was programmed and processed using SPSS 21. Participants were only recognized by their unique identification number assigned initially through the survey database. Their answers to survey questions were only used in the context of summarizing findings for the entire study in which no individual's answers can be identified. These two steps ensured confidentiality. Types of data collected were nominal (qualitative), ordinal (rank-order), and scalar (numeric data on an interval or ratio scale).

Survey results are described in subsequent sections below. Multiple statistical techniques were used with data collected from returned questionnaires. We have broken down this chapter into descriptive statistics, difference of means tests (ANOVA and t-tests), component analysis, and two multiple regression models concerning wildfire risk perception and prescribed fire perception.

Section 4.1 Descriptive Statistics

Descriptive statistics are outlined below. Because so many variables were different scales of data (ordinal, nominal, and interval) describing statistics in specific categories (i.e. sociodemographics etc.) via tables is difficult to achieve in a concise manner. For more details concerning actual survey results on

a question by question basis please refer to Appendix D. We have structured descriptive tables below in the following manner:



	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Serve on a Committee or Board	84.8	4.5	10.8	0.56	0.31
Vote	7.2	5.6	87.1	3.51	0.29
Visit Public Land	3.5	—	96.5	0.96	0.19
Visit Frequency[2]	—	—	—	2.57	1.06

[2] 1=once a yr; 2=several times a yr; 3=several times a mth; 4=several times a wk; 5=daily

Sociodemographics: Descriptive statistics for sociodemographic based questions are outlined in Table 4-2. Survey respondents were overwhelmingly white/non-minority in their racial makeup (99.3%). The few survey respondents that did not self-identify themselves as white were either white/black or considered themselves white/Native American. Our survey had a 60/40 male to female ratio. The average survey respondent was more than 59 years in age; significantly older than the median age reported for counties in the US Census (refer to Table 2-1). Average household size is less than 3 persons with the majority of respondents being married (76.1%) and with no children at home (42.8%). The majority of residents in the WUI do not have a college degree (nearly 60%). Respondents were primarily retired (41.4%) or in a service sector occupation if they were currently employed (40.9%). Nearly 5% of respondents were unemployed or disabled (Figure 4-1). Average household income of survey respondents is $37,400; less than the median income reported for counties in the US Census ($44,361). More than 10% of respondents

were classified as meeting Federal poverty guidelines based on household size[6]. Ideologically, survey respondents were primarily mixed/moderate in their political views (48.2%) but conservatives made up a stronger cohort than liberals (40.9%).

Table 4-2. Survey Respondents' Sociodemographic Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Age[1]	—	—	—	59.36	14.11
Sex (male/female)	40.1	—	59.9	0.60	0.49
Race[2]	—	—	—	1.04	0.42
Minority Status	99.3	—	0.7	0.01	0.08
Marital Status[3]	—	—	—	4.65	1.62
Have Children at Home	69.1	—	30.9	0.83	0.37
# of Persons < 18[4]	—	—	—	1.91	1.08
# of Persons > 18[4]	—	—	—	1.98	0.62
Total Household Size[5]	—	—	—	2.45	1.22
Education[6]	—	—	—	3.46	1.41
Income[7]	—	—	—	4.16	1.79
Occupational Sector[8]	—	—	—	3.44	0.92
Poverty	89.0	—	11.0	0.11	0.32
Political Views[9]	—	—	—	2.55	0.95

[1] Min= 19; Max= 90
[2] 1=white; 2=African American; 3=Native American; 4=Asian; 5=Latino/Hispanic
[3] 1=single; 2=single w/child @ home; 3=single no child @home; 4=married; 5=married w/child @ home; 6=married no child @home
[4] Min= 1; Max = 5
[5] Min= 1; Max= 7
[6] 0=<HS; 1=HS; 2=some college; 3=Assoc.; 4=BA/BS; 5=>BA/BS
[7] 1=<$15k; 2=$15-$25k; 3=$25-$35k; 4=$35-$50k; 5=$50-$75k; 6=$75-$100k; 7=$100-$150k; 8=>$150k
[8] 0=unemployed/disabled; 1=agriculture; 2=goods producing; 3=service providing; 4=retired
[9] 1=cons. conservative; 2=most conservative; 3= moderate; 4=most liberal; 5=cons. Liberal

[6] US Census Bureau Federal Poverty Threshold (2014) http://www.census.gov/hhes/www/poverty/data/threshld/

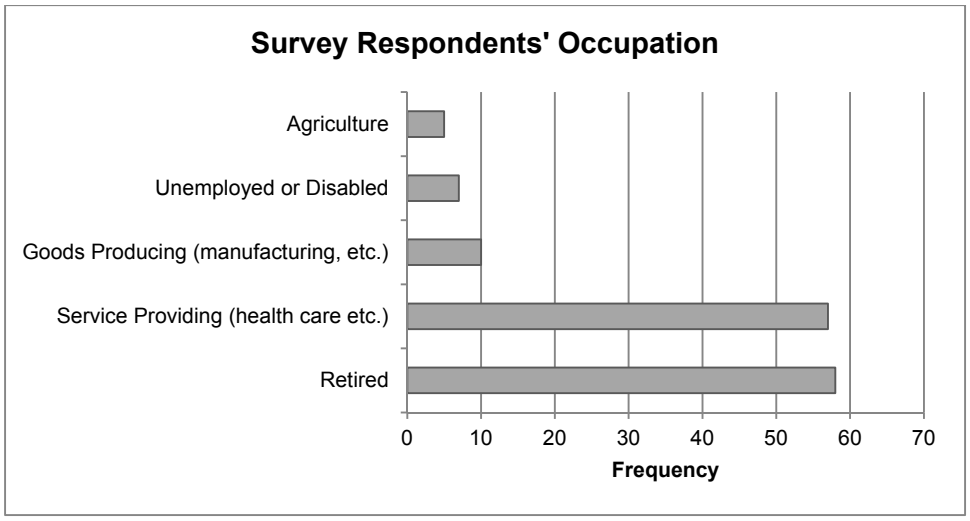


Figure 4-1. Survey respondents' occupation (by occupational sector)

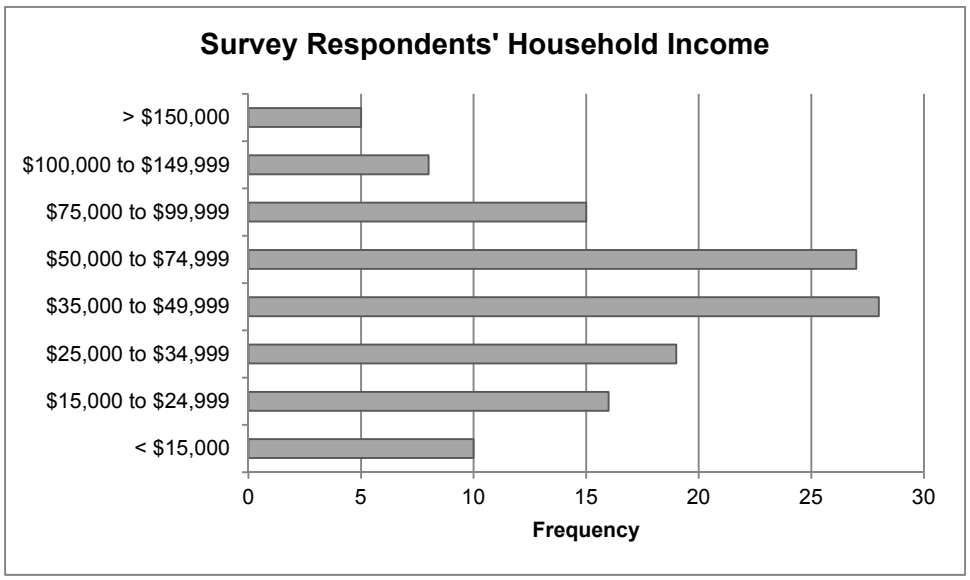


Figure 4-2. Survey respondents' average household income ($)

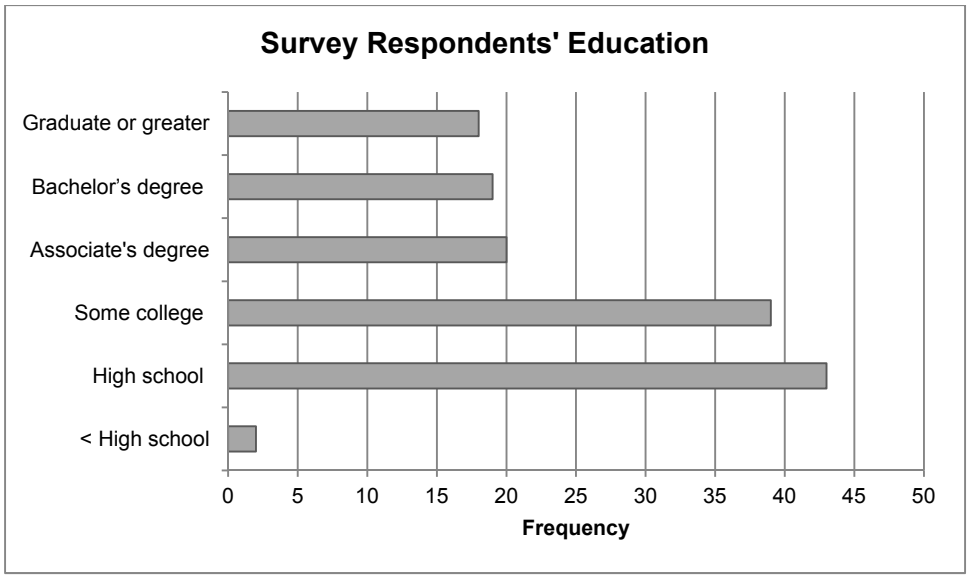


Figure 4-3. Survey respondents' educational attainment

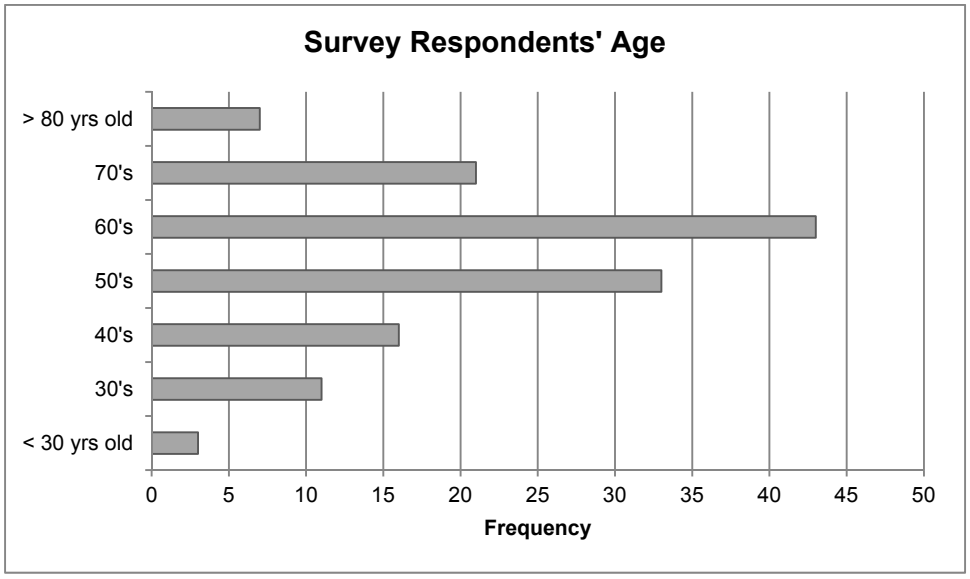


Figure 4-4. Survey respondents' age by age class

Locality and Land Management: Descriptive statistics for locality based questions are outlined in Table 4-3. Residents on average have lived approximately 22 years at their current property. Residents in the WUI live universally in single-family homes (81.4%) with mobile home owners (including self-identified double-wide owners) making up only 17.1%. Other housing types that respondents self-reported were small cabins or barns with living quarters. Most of the residents in the WUI fall broadly into rural or

exurban residential areas (48.6% and 32.1% respectively). A third category we included in the survey was an old town/settlement choice as a residential area. These represent areas that in the past may have had larger populations but now are little more than a cluster of houses in a census designated place. While not dominant, residents in suburban areas (9.3%) and old town/settlements (9.3%) made up a small cohort. Housing proximity (the distance from a respondent's house to the nearest house or outbuilding that lies outside their property line) is typically more than 100 feet (77.5%). Additionally a strong majority of survey respondents reported that they own (85.6%) and insure (90.4%) their home and/or property. Many residents in the WUI reported owning land in the community (close to 90%). Reported acreages range from less than one acre to 500 acres. A majority of respondents own parcels less than 25 acres; the median parcel size throughout the WUI was 17.5 acres[7]. Typical of exurban areas, few respondents in the WUI rely on their land for some income (21.9%). A minority of residents in the WUI actively seeks out advice for the management, care, or protection of their land (30.5%) and an even smaller number actively enrolled their land in a conservation status (12.3%). Despite this, respondents are not experiencing the parcelization pressure commonly documented throughout the state. A majority of them are unlikely to sell or give away their land in the next 5 to 10 years (72.0%). Nearly 70% of survey respondents stated that they actively managed their land. Landowners in the WUI manage their parcels for multiple uses; both consumptive and non-consumptive (Figure 4-2). Foremost of all of these management activities was landscaping and gardening (69.3%) followed by soil conservation and erosion control (44.3%) and timber production and harvest (39.8%).

[7] The median was reported here due to statistical outlier acreages in the survey.

Table 4-3. Survey Respondents' Locality & Land Management Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Permanent Resident	1.5	—	98.5	0.98	0.12
Yrs. at Property[1]	—	—	—	21.91	16.02
Housing Type[2]	—	—	—	2.22	0.46
Own	14.2	—	85.8	0.86	0.35
Insure	10.2		89.8	0.90	0.30
Residential Area[3]	—	—	—	1.81	0.99
Housing Proximity[4]	—	—	—	2.70	0.61
Own Land in the Community	9.9	—	90.1	0.90	0.30
Acres of Land[5]	—	—	—	47.17	77.89
Portion of Income from Land	78.1	—	21.9	0.22	0.42
Received Mgmt. Advice	69.5	—	30.5	0.30	0.46
Conservation Status of Land	86.6	—	13.4	0.13	0.34
Considering Selling or Giving Away	72.6	10.9	16.5	1.98	1.27
Actively Manage Their Land	31.3	—	68.8	0.69	0.47

[1] Min= 1; Max= 67

[2] 1=multi family house; 2=single family house; 3=mobile home/trailer

[3] 1=rural/farm; 2=exurban; 3=old tow n/settlement; 4=suburban; 5=urban

[4] 1=<25 ft; 2=25-100 ft; 3=>100 ft

[5] Min= 1; Max= 500

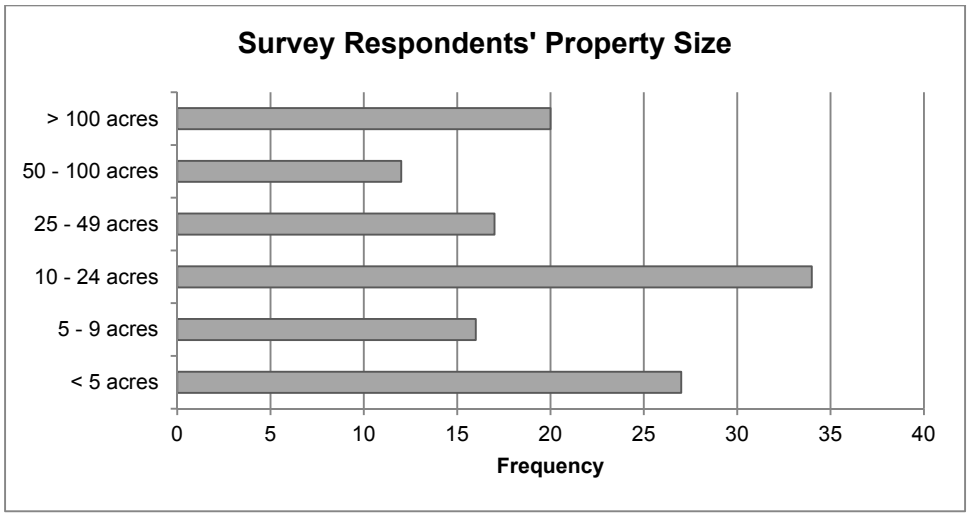


Figure 4-5. Survey respondents' property size in acres

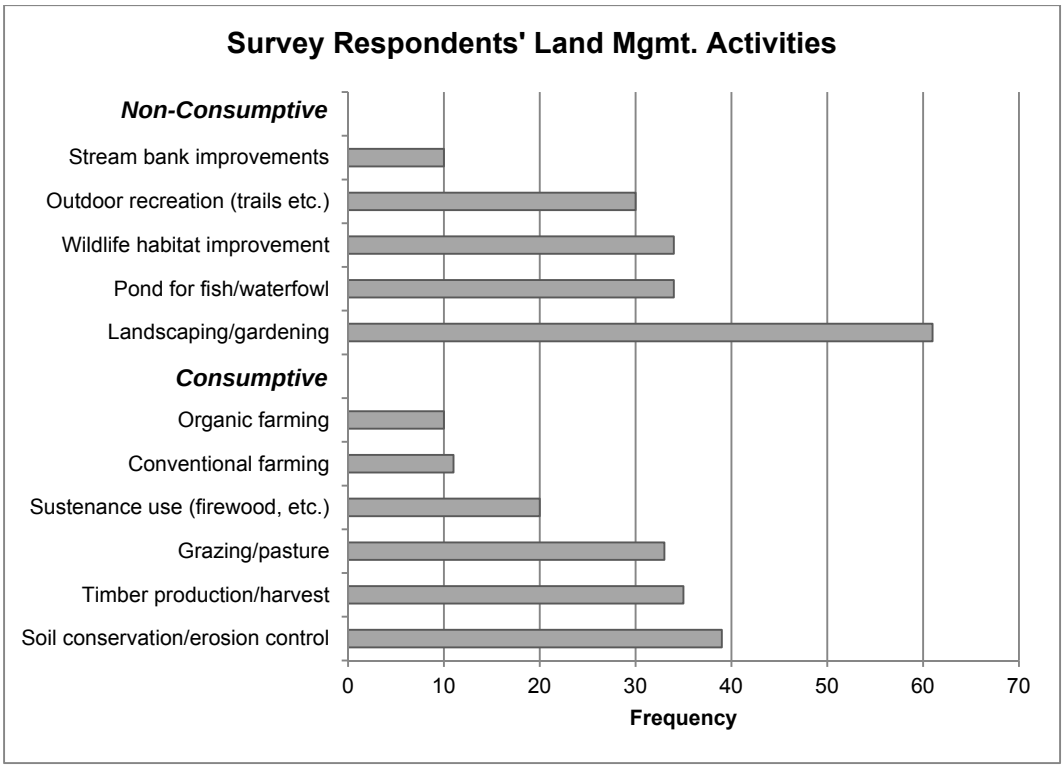


Figure 4-6. Survey respondents' land management activities

Community: Descriptive statistics for community based questions are outlined in Table 4-4. Residents throughout the WUI are community fixtures. On average they have lived more than 34 years in their respective communities. Respondents expressed a variety of reasons for deciding to live in southern Indiana (Figure 4-7). They include economic reasons (affordable housing, better cost of living, etc.), social reasons (privacy, less government regulation and taxes, etc.) and place based reasons (outdoor amenities and recreation, new/better housing, etc.). Foremost of all of these motivations were ties to family, the local community, and land (63.6%) followed closely by beautiful scenery (61.5%) and privacy (53.1%). Respondents' differed in their next higher rankings for motivation. Pleasant Run residents expressed a stronger affinity toward outdoor amenity rich landscapes (41.2%). Residents in Lost River expressed strong motivations for affordable land (34.8%) and Patoka River residents desired an escape from urbanism (37.5%) followed closely by affordable land (31.3%). Tell City residents were drawn strongly to good neighborhoods (46.3%) and schools (31.5%). More than 80% of respondents in the WUI have attended a local community event or festival in the past year. Residents are mixed in their community participation (Figure 4-8). Only 31.9% of respondents stated they had gone to a public

meeting addressing community issues, but nearly half stated they had contacted an official about some local issue of concern (48.1%). Residents in the WUI were inexperienced when it came to serving their community in some capacity. Only 15.4% of respondents had served as an officer in a community organization (i.e. homeowners association) and an even smaller group had experience serving on a local government committee or board (10.4%). Voting however is something that nearly every resident in southern Indiana does. 91.2% of respondents stated that they had voted in an election in the last year[8]. A high percentage of residents in the WUI visit the HNF, State Parks, Forests, and Fish and Wildlife areas for recreation or employment (96.5%). On average, they frequent these places more than several times a year. Yet they seldom interact with natural resource professionals at these places or in the community. 78.1% stated they rarely or only sometimes talked to these people.

Table 4-4. Survey Respondents' Community Perception Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Yrs in Community[1]	—	—	—	34.30	22.16
Quality of Life	1.4	17.7	80.8	4.18	0.80
Local Economy	34.0	39.1	26.8	2.88	1.01
Places to Visit/Recreate	12.5	25.7	61.7	3.73	1.03
Availability of Affordable Housing	16.0	42.0	42.0	3.30	0.96
Local Government	24.8	55.5	19.7	2.96	0.91
Communication Among Residents	14.4	40.3	45.4	3.45	1.00
Providing Necessary Services	23.5	45.6	30.9	3.08	0.96
Safety/Crime	11.5	30.0	58.5	3.65	1.02
Cost of Living	10.8	43.2	46.0	3.46	0.88
Community's Change over Time	19.8	55.9	24.2	3.04	0.87
Participate in Community Event	19.3	35.4	45.4	2.42	0.39
Attend a Public Meeting	64.7	22.7	12.6	1.21	0.47
Served as an Officer	77.4	7.0	15.7	0.77	0.36
Contact a Local Official	54.1	26.7	19.2	1.36	0.50
Serve on a Committee or Board	84.8	4.5	10.8	0.56	0.31
Vote	7.2	5.6	87.1	3.51	0.29
Visit Public Land	3.5	—	96.5	0.96	0.19
Visit Frequency[2]	—	—	—	2.57	1.06
Interact With Resource Pros[3]	—	—	—	1.42	0.83

[1] Min= 1; Max= 88
[2] 1=once a yr; 2=several times a yr; 3=several times a mth; 4=several times a wk; 5=daily
[3] 0=never; 1=rarely; 2=sometimes; 3=often

[8] 2014 had midterm elections.

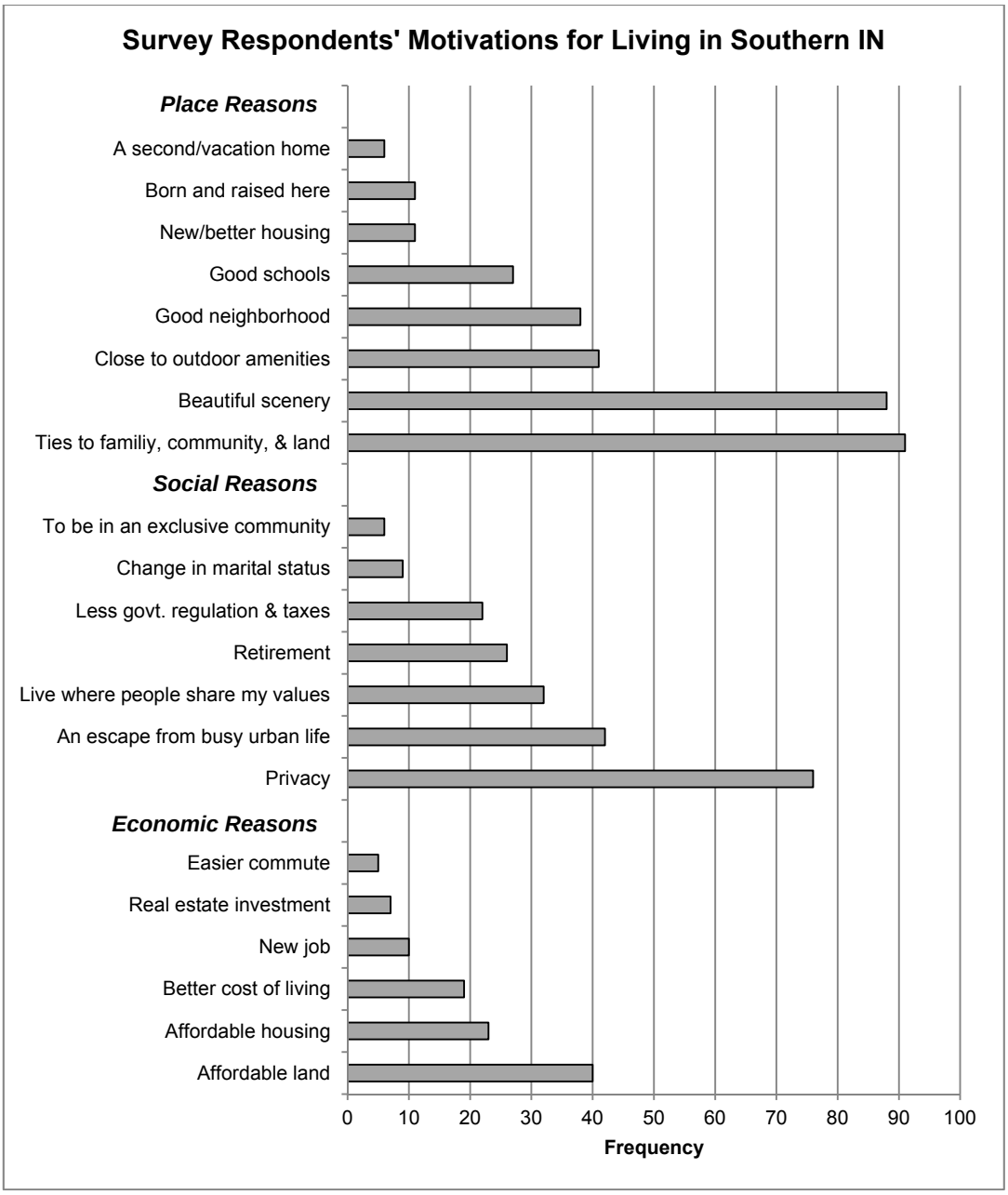


Figure 4-7. Survey respondents' primary motivations for living in southern Indiana

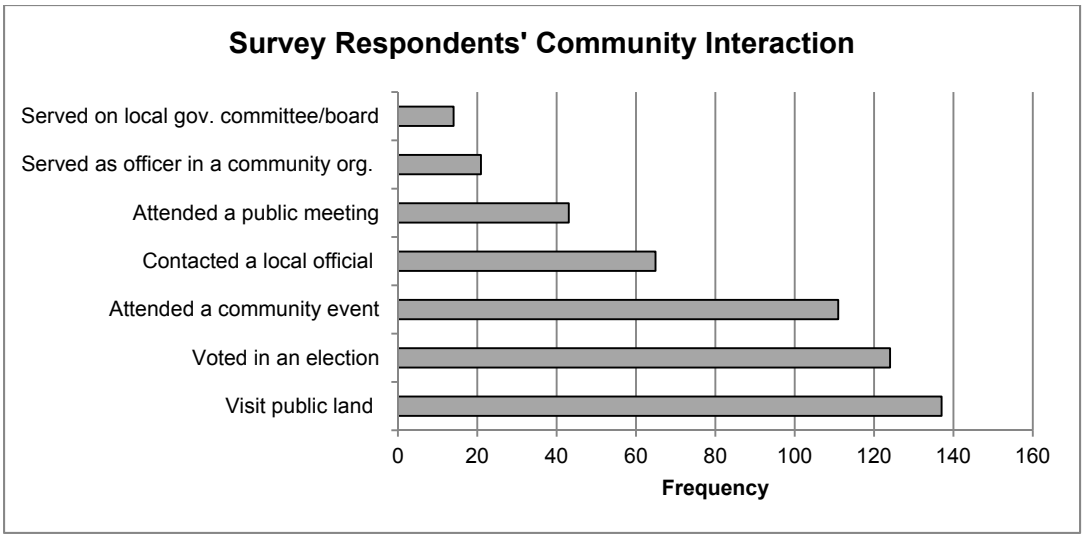


Figure 4-8. Survey respondents' community interaction

Views on Environment and Natural Resources: Descriptive statistics for questions involving respondents' perceptions of environmental risk and man's place in the Indiana's public lands are outlined in Table 4-5. When asked what forest risks were of concern, respondents felt that harmful pests (67.7%) loss of farmland (62.5%) and forests to development (61.8%) were most concerning. Decline in wildlife habitat (60%), loss of open space and scenic beauty (58.7%), erosion and soil loss (52.3%), and quality access to public lands for outdoor recreation (50%) were also moderate/high concern categories. Wildfire (46.4%) and invasive species (40.4%) were considered more of a low/moderate risk. Typical of the wider public, climate change as a forest risk was a divisive issue. 20.4% of respondents believed it posed no concern and nearly that many (19.0%) believed it was very concerning. Respondents typically took a preservationist stance on natural resource use issues. Many felt it is important to set aside land for wilderness to protect it from possible development (58.7%) as well as protecting ecosystems, endangered species, and wildlife habitat, even if that means hurting some industries (57%). A majority also felt that economic growth was not more important than the environment (73.2%). Respondents were mixed however when it came to questions involving conservation and sustainable use. Most respondents disagreed that the needs of people in the present are more pressing than future generations (69.3%) and also disagreed that people have a right to modify the natural environment to meet their needs (51.4%). The average respondent is neutral when it comes to the perception that local economic concerns play too

great a role in multiple use management decisions on Indiana's public lands (μ = 3.01). They were also neutral when it came to improving access on public lands (μ = 3.09) as well as the expectation of land managers to provide natural resources to support local industries which depend on them (46.3%). However, when asked if Indiana's public land should be managed for multiple uses (timber harvesting, outdoor recreation, wildlife, etc.) a majority of respondents agreed (73.9%). When it came to who should be administering the resources of Indiana's public land they primarily expressed that the government is more effective than the private sector (45.6%) but a strong majority of respondents felt that residents should have more of a role in decisions impacting those lands (76.1%).

Table 4-5. Survey Respondents' Views on Environment & Resources Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Wildfire	19.6	46.4	34.1	2.23	1.05
Harmful Pests	10.3	22.1	67.7	2.91	1.01
Decline in Wildlife Habitat	17.8	22.2	60.0	2.66	1.17
Forest Loss	14.7	23.5	61.8	2.80	1.16
Farm Loss	17.6	19.9	62.5	2.75	1.21
Invasive Species	25.0	40.4	34.6	2.13	1.06
Loss of Forest Jobs & Resources	18.4	40.4	41.1	2.30	1.04
Loss of Open Space/Aesthetics	18.8	22.5	58.7	2.57	1.17
Erosion & Soil Loss	20.2	27.6	52.3	2.46	1.06
Quality Access for Recreation	23.6	26.5	50.0	2.36	1.22
Climate Change	35.0	29.2	35.8	1.99	1.38
Future Generations have Less Need	69.3	22.6	8.0	2.04	1.10
More Wilderness	21.0	20.3	58.7	3.57	1.36
Managers Should Provide Resources	22.0	46.3	31.6	3.13	0.96
IN Lands Should be Multi-Use	12.3	13.8	73.9	3.96	1.12
Protect Ecosystems & Endang. Species	14.1	28.9	57.0	3.75	1.10
Gov. Should Not Manage IN Lands	45.6	32.4	22.1	2.67	1.25
Managers Should Expand Access	31.7	32.4	36.1	3.09	1.23
Economic Growth More Important	73.2	21.7	5.0	1.94	0.94
People Have a Right to Modify the Env.	51.4	27.5	21.0	2.56	1.25
Local Economy to Influential	25.2	48.9	25.9	3.01	0.97
Residents Should Have Active Role	4.4	19.6	76.1	4.05	0.92

Wildfire: Descriptive statistics for wildfire based questions are outlined in Table 4-6 and 4-7. When asked what phrase they would use to describe wildfire most survey respondents used strong, emotional terms. Most described it as "out of control", "dangerous", "scary", and "devastating". Wildfire was ranked as a

medium environmental hazard (μ = 4.2) to WUI respondents, on par with drought (μ = 4.2), while severe weather (μ = 2.38) and tornadoes (μ = 2.69) were consistently described as the greatest natural disaster threat to their community (Figure 4-9). Residents' knowledge of wildfire terms and organizations was poor. Nearly 70% of all respondents had never heard of WUI, defensible space, Firewise[9], and fire adapted communities. However, more than 9 out of 10 were knowledgeable of prescribed fire. Most respondents did not perceive a high risk to their home from wildfire (40.6%); however they self-reported higher perceived risk of the land adjacent to their home (52.1%) as well as their neighbor's property (45.1%), the community (36.1%), and the wider region (46.5%). Nearly 30% of respondents knew someone who had experienced a wildfire, had a home or property damaged by smoke or wildfire, or evacuated due to the threat of a wildfire. 23.2% of respondents had personally experienced a wildfire on or near their property in the past, and of those that reported so, close to 15% stated that they had had their property damaged as a result of that fire. The fire fighters that responded to the wildfire were typically the local fire department (41.1%) and the land owners themselves (37.5%) with federal and state agencies representing a smaller group (16.1%). Respondents were predominantly positive in their views on the fire fighters who responded to the fire; however a small number of respondents reported that they would not place a great amount of trust in their ability to respond to a larger fire in an effective manner (32.2%). Respondents were more mixed in activities commonly conducted by homeowners to reduce their risk to wildfire. Most stated that they had never contacted a governmental agency for information concerning wildfire, participated in community fuels reductions, or spoke to a neighbor about wildfire. Residents were mixed in their use of fire resistant materials on their home and outbuildings. Nearly 50% of respondents in Lost River, Pleasant Run, and Tell City had done so. Although they may not be familiar with the concept of defensible space, a strong majority of residents in the WUI strongly reported they had cleared vegetation and litter around their home and property to reduce wildfire risk (81.9%). Respondents were inconsistent with their views on private citizens' role in reducing wildfire hazards on their property. 58.2% stated that they strongly disagreed that reducing wildfire hazards is not the homeowner's problem and 45.3% stated they strongly disagreed with the polar opposite of this statement; reducing wildfire hazards is entirely the homeowner's responsibility. Most respondents agreed that reducing wildfire

[9] Firewise is a community outreach project of the National Fire Protection Association http://www.firewise.org/

hazards is best left to private organizations, companies, and communities (72.2%) as well as residents need to prepare for a wildfire but with cost sharing and incentives from institutional organizations (insurance, government agencies, etc.) to offset the burden on private citizens (47.1%).

Table 4-6. Survey Respondents' Wildfire Risk Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
WUI (Interface/Intermix)	—	—	—	0.36	0.48
Hazard Rank - Wildfire[1]	—	—	—	4.20	1.60
Risk Perception - Home[2]	40.6	25.9	33.6	1.91	1.27
Risk Perception - Land Around Home	22.6	25.4	52.1	2.44	1.24
Risk Perception - Neighbors Property	26.1	28.9	45.1	2.30	1.23
Risk Perception - Community	27.6	36.2	36.1	2.09	1.12
Risk Perception - Region	19.1	34.5	46.5	2.31	1.09
Knowledge - Wildfire Terms	89.5	—	10.5	0.73	0.98
Knowledge - Rx Fire	6.3	—	93.7	0.94	0.24
Know Someone who Experienced a Fire	70.4	—	29.6	0.30	0.46
Personally Experienced Fire	76.8	—	23.2	0.23	0.42
Had Smoke Damage*	87.9	—	12.1	0.12	0.33
Had Fire Damage*	84.8	—	15.2	0.15	0.36
Fire Fighters were Prepared*	13.0	12.9	74.2	3.87	1.15
Fire Fighters had Eqpt.*	22.6	16.1	61.3	3.48	1.39
Trust in Fire Fighters*	32.2	12.9	54.9	3.29	1.42
Talk to a Neighbor about Fire	62.6	21.1	16.2	2.21	1.26
Clear Defensible Space	25.2	15.4	59.3	3.50	1.44
Build with Fire Resistant Material	36.1	30.3	33.6	2.96	1.36
Participate in Fuels Reduction	56.1	24.4	19.6	2.43	1.28
Contact USFS/DNR about Fire	56.1	25.2	18.7	2.38	1.28
Neighbor did Risk Reduction Activity	55.4	—	44.6	0.45	0.50
Reducing Risk - Not Individual Respon.	78.1	14.2	7.8	1.76	1.10
Reducing Risk - Communities and Orgs.	72.2	16.4	11.4	2.01	1.14
Reducing Risk - Incentivize	27.2	25.7	47.1	3.24	1.27
Reducing Risk - Individual Respon.	64.0	20.9	15.2	2.15	1.31

[1] Hazard rank; 1=lowest 7=highest

[2] 0=no risk; 2=low risk; 3=mod. risk; 4=high risk

* only respondents who experienced a fire answered

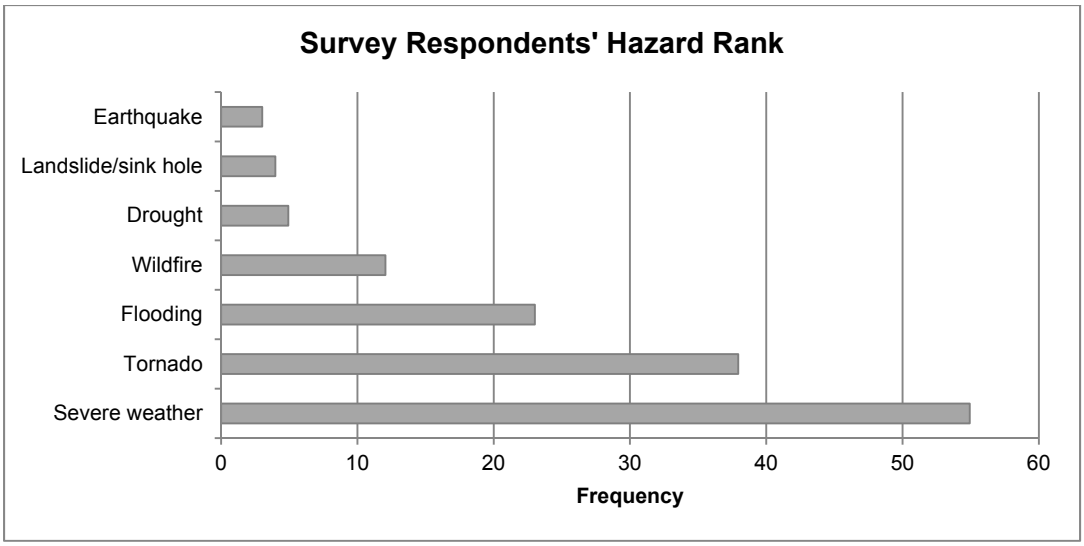


Figure 4-9. Survey respondents' highest natural hazard ranking

Respondents' perceptions of wildfire and its place in Indiana's landscape were mixed. Most believed fire is necessary to maintain a natural balance (48.9%), and that fire is beneficial to some of Indiana's native plants, trees, and wildlife (59.9%). Respondents were more varied in their opinions of wildfire suppression. Most agreed that fire should be managed for resource benefits and only suppressed as a last resort (50.4%), while their opinion on the danger of wildfire was mostly neutral considering their emotional responses at the beginning of the questionnaire (40.4%). Ignition risks that respondents felt strongly contributed to wildfire risk in the community were careless burning (78.4%), natural processes such as drought, lightning, etc. (54.7%), the build-up of vegetation on public land (47.5%) and private land (38.4%), and arson (43.5%). Contributing factors that respondents were less concerned about were local management of land (62.2%), climate change (56.9%), prescribed fire (52.2%), increased housing being built (47.1%), timber harvesting (42.0%), and harmful pests (35.7%). They were ambivalent in their view of recreational use on public land as an ignition risk (35.3%).

Table 4-7. Survey Respondents' Views on Wildfire and Ignition Risk Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Fire is Beneficial	11.7	28.5	59.9	3.73	1.15
Fire is Unnecessary	48.9	32.1	19	2.55	1.18
Fire is Dangerous	22.1	40.4	37.5	3.29	1.22
Fire Should be Managed	21.9	27.7	50.4	3.38	1.26
Fire had a Greater Impact in the Past	17.3	46.6	36	3.32	1.07
Ignition Risk - Public Land Veg.	22.3	30.2	47.5	2.40	1.18
Ignition Risk - Private Land Veg.	28.2	33.3	38.4	2.15	1.09
Ignition Risk - Increased Housing	47.1	31.6	21.3	1.57	1.08
Ignition Risk - Timber Mgmt.	42	33.3	24.7	1.75	1.15
Ignition Risk - Arson	36.2	20.3	43.5	2.12	1.38
Ignition Risk - Careless Burning	9.4	12.2	78.4	3.13	1.03
Ignition Risk - Recreational Use	30.2	35.3	34.5	2.02	1.09
Ignition Risk - Pests	35.7	33.6	30.7	1.96	1.24
Ignition Risk - Natural Processes	12.3	33.1	54.7	2.58	0.96
Ignition Risks - Public Land Mgmt.	48.2	32.6	19.3	1.63	1.11
Ignition Risk - Rx Fire	52.2	26.8	21	1.60	1.19
Ignition Risks - Local Land Mgmt.	62.2	27.4	10.4	1.30	0.99
Ignition Risk - Climate Change	56.9	28.8	14.4	1.32	1.09

Prescribed Fire: Descriptive statistics for prescribed fire based questions are outlined in Table 4-8. When asked what phrase they would use to describe prescribed fire most survey respondents were diverse in their choice words. The majority stated positive responses like "necessary", "beneficial", or "helpful", but there were also a minor number of negative responses like "ugly", "unnecessary", or "scary". Evidence to how active the DNR and USFS has been with the use of prescribed fire in the greater HNF area is the number of respondents who had observed or heard of prescribed fire. 44% of survey respondents had seen or been informed of a prescribed fire being conducted near their property in the past, a large number considering most people never experience this resource management tool near their residence. However, when the time scale shrinks to within a year, nearly half the respondents had heard nothing regarding prescribed fire in their community. Respondents that had heard something in the last year primarily received their information from the newspaper (23.5%), word of mouth (22.8%), and their own personal observations (18.5%) (Figure 4-10). When asked which source of information they trusted the most when it came to providing accurate and reliable information about prescribed fire, most respondents chose newspapers (14.0%) and government entities like the DNR/USFS (12.6%). They chose word-of-mouth

and gossip as the most distrustful source (24.5%). Respondents are mixed in their views on prescribed fire in their community. Many positively viewed prescribed fire as a valuable land management practice (μ = 3.14) and did not view its use as reckless or its impact as negative (μ = 2.21). Most did not perceive prescribed fire to be as dangerous as wildfire to public safety (65.4%). Additionally, most did not perceive the smoke generated from a prescribed fire to be as much of a threat to public health and air quality as that of a wildfire (43.2%). A majority of respondents were not concerned with prescribed fire aesthetically degrading a landscape (58.4%). They also strongly felt that prescribed fire improved wildlife habitat and hunting opportunities (57.1%) as well as being necessary for a healthy forest ecosystem (62.4%). When it came to the threat of prescribed fire escaping control, respondents were neutral in their views. 37.7% disagreed that they were concerned while nearly that many expressed they were (36.2%). Respondents also were neutral in their trust in the government to make proper decisions about the use of prescribed burning (μ = 3). A majority of respondents also felt that the government should be restricted in its use of prescribed fire. Many felt the government should not use prescribed burning as a tool whenever they see fit (43.5%). They also mainly agreed with the perception that prescribed burning should be used infrequently, in carefully selected areas, and only with public approval (44.3%). Over time most respondents were neutral in how their views positively changed to perceive prescribed fire (41.3%).

Table 4-8. Survey Respondents' Views on Prescribed Fire(Rx Fire) Statistics

	Neg./Low (%)	Neu./Mod. (%)	Pos./High (%)	Mean	SD
Been Informed of Rx Fire Near House	56.0	—	44.0	0.44	0.50
In the Last Yr. Heard in the Community[1]	—	—	—	0.82	0.98
Rx Fire is Dangerous	65.4	16.5	18.0	2.29	1.23
Smoke from Rx Fire is Harmful	43.2	24.5	32.4	2.86	1.24
Concern for Escaped Rx Fire	37.7	26.1	36.2	3.01	1.18
Rx Fire Damages Beauty/Aesthetics	58.4	25.5	16.0	2.38	1.20
Rx Fire is Beneficial to Wildlife	22.2	20.7	57.1	3.53	1.26
Rx Fire is Necessary for Forests	15.2	22.5	62.4	3.70	1.22
Trust in Gov.	33.8	29.5	36.7	3.00	1.27
Gov. Should Adopt Rx Fire as Tool	43.5	30.4	26.1	2.71	1.20
Rx Fire Should Have Public Approval	20.7	35.0	44.3	3.38	1.10
Rx Fire is a Valuable Mgmt. Practice	24.8	38.7	36.5	3.14	1.17
Rx Fire is a Reckless Mgmt. Practice	63.8	22.5	13.8	2.21	1.23
Views Have Changed to be Accepting	31.9	41.3	26.8	2.90	1.12

[1] 0=none; 1=a little; 2=mod. amount; 3=a great deal

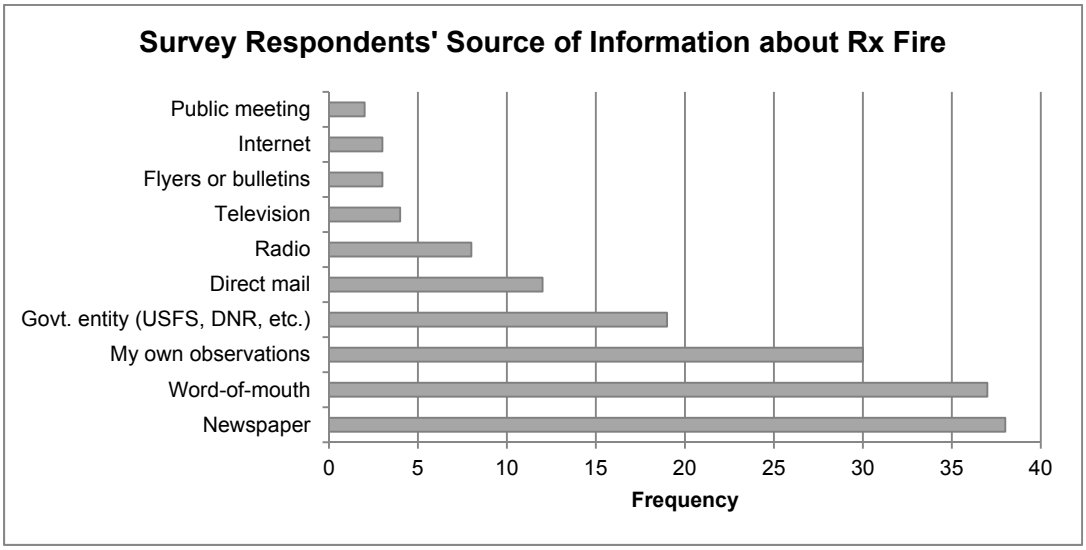


Figure 4-10. Survey respondents' source of information concerning prescribed fire

Section 4.2 WUI & Mgmt. Area Difference Tests

We used counties as our sampling metric for this survey because it was the logical choice given the nature of our household survey database. However, to aid natural resource managers in the greater HNF area to make management decisions according to the needs of specific management areas, we have

aggregated our survey results by HNF management areas where possible. Further, after the survey was returned, we also wanted to explore possible differences among respondent's perceptions in the newly generated WUI GIS dataset. For example, do respondents exhibit different behaviors and characteristics whether they reside in interface or intermix? What can be inferred from residents' perception of wildfire and prescribed fire based on where they live? WUI GIS data was joined to the survey responses by intersecting respondents address data with our complete WUI dataset in ArcGIS 10.2 and appending data to our survey database.

An analysis of variance (ANOVA) was conducted in SPSS 21 to compare HNF management areas and a wide selection of variables that have the potential to show some variance or have some bearing on how people think about and perceive wildfire and prescribed fire. In addition, an independent t-test was conducted for WUI because of the dichotomous nature of this variable (interface/intermix). The independent t-test compares the means between two unrelated groups on the same continuous, dependent variable. ANOVA provides an inferential test of whether or not the means of several groups are equal, and therefore generalizes the t-test to more than two groups. ANOVA (and the independent t-test for dichotomous variables) can be used as an exploratory tool to explain observations, in this case empirically testing whether or not means for our chosen variables exhibit significant differences from the rest of the variables in aggregate. Various post-hoc tests[10] were conducted on the data to determine which specific groups differed. Homogenous data (exhibiting equal variance) had a Tukey honestly significant difference (HSD) test conducted while non-homogenous data (exhibiting unequal variance) received a Games-Howell (G-H) test. Variables that reject the null hypothesis[11] are illustrated in Table 4-9 for WUI and Table 4-10 for HNF management areas.

[10] Post-hoc tests are termed a posteriori tests; they are conducted after significance is assigned in an ANOVA.
[11] That all groups are simply random samples of the same population.

Table 4-9. WUI Independent T-Test Significant Variables

	Interface	Intermix	F	t	*p* (2-tailed)
Freq. visiting public land	2.33	2.98	9.44^{H_0}	-3.53	0.001**
Selling/giving land soon	1.80	2.31	3.74^{Ha}	-2.11	0.038*
Education	3.26	3.82	0.14^{Ha}	-2.27	0.025*
Protect ecosystems, habitat, etc.	3.49	4.18	2.69^{Ha}	-3.79	0.000**
Fire should be managed for benefits	3.21	3.69	3.81^{Ha}	-2.29	0.024*
Risk Perception - Home	1.72	2.25	2.48^{Ha}	-2.56	0.012*
Motivation - Outdoor amenities/rec.	0.23	0.39	0.73^{Ha}	-2.00	0.048*
Motivation - Place attachment	0.71	0.51	0.82^{Ha}	2.31	0.023*
Spoke to a neighbor about wildfire	0.32	0.14	29.68^{H_0}	2.38	0.019*

*** $p < .001$, ** $p < .01$, * $p < .05$.
^{Ha} - unequal variance; ^{H_0} - equal variance

WUI: WUI respondents differed in their perceived risk to their homes. Residents whose address was modeled intermix (x^1), reported higher perceived risk than their interface (x^0) counterparts ($x^1 = 2.25$, $x^0 = 1.72$; p = 0.012). They also differed in how much they interacted with their neighbors when it came to discussing wildfire. Residents whose address was modeled interface reported higher levels of interaction; 32% stated they had spoken to a neighbor about wildfire in the past, while only 14% of intermix residents did, which was much less than the survey population as a whole at 26%. WUI respondents differed in their views on resource preservation and the use of wildfire as a resource tool. When it came to respondents views on protecting ecosystems, endangered species, and wildlife habitat (even if it means hurting some industries), intermix residents reported higher agreement than the survey population as a whole, while interface residents reported lower ($x^1 = 4.18$, $x^0 = 3.49$; p = 0.000). Intermix residents also more positively viewed the use of wildfire for resource benefits (and only suppressed as a last resort) than their interface counterparts ($x^1 = 3.69$, $x^0 = 3.21$; p = 0.024). Intermix residents also visited public lands for recreation or employment more frequently than interface residents ($x^1 = 2.98$, $x^0 = 2.33$; p = 0.001). Interface residents were far more likely to live in the greater HNF area because of ties to family, local community, and the land ($x^1 = 0.51$, $x^0 = 0.71$; p = 0.023), while intermix residents were more likely to live in the greater HNF area due to their proximity to outdoor amenities and recreation ($x^1 = 0.39$, $x^0 = 0.23$; p = 0.048). Another surprising difference between WUI respondents was in their parcelization behavior. Intermix residents reported a higher likelihood of selling or giving away their land in the next

five to ten years, while interface residents were less likely ($x^1 = 2.31$, $x^0 = 1.8$; p = 0.038). Finally, WUI respondents had different educational levels. Intermix residents in general exhibited higher educational attainment than their interface cohorts ($x^1 = 3.82$, $x^0 = 3.26$; p = 0.025).

Table 4-10. HNF Management Areas ANOVA Significant Variables

	Pleasant Run[a]	Lost River[b]	Patoka River[c]	Tell City[d]	*W*	F	*p*	Post-Hoc
WUI (interface/intermix)	0.50[c]	0.52[c]	0.16[ab]	0.31	14.79[Ha]	4.16	0.007**	*G-H*
Rank - Landslide	6.03[c]	5.10	5.0[a]	5.64	3.93[Ha]	3.20	0.025*	*G-H*
Informed of Rx fire in past	0.41	0.29[d]	0.25[d]	0.63[bc]	3.52[Ha]	5.32	0.002**	*G-H*
Heard about Rx fire lately	0.59[d]	0.57[d]	0.66	1.19[ab]	2.27[H0]	4.25	0.007**	*HSD*
Rx fire is dangerous	1.91[b]	2.86[a]	2.38	2.25	2.72[Ha]	2.83	0.041*	*G-H*
Smoke from Rx fire is hzd.	2.36[b]	3.55[a]	2.75	2.96	1.10[H0]	4.57	0.004**	*HSD*
Quality of life percept.	4.24	3.74[d]	4.09	4.38[b]	3.41[Ha]	3.86	0.011*	*G-H*
Local economy percept.	3.34[bc]	2.48[a]	2.53[a]	2.98	0.48[H0]	5.41	0.002**	*HSD*
Affordable housing pcpt.	3.21	3.09	3.03[d]	3.61[c]	0.71[H0]	3.21	0.025*	*HSD*
Crime percept.	3.79	3.04[d]	3.44	3.96[b]	3.83[Ha]	5.51	0.001***	*G-H*
Motivation - Schools	0.15	0.04[d]	0.13	0.31[b]	16.24[Ha]	3.49	0.018*	*G-H*
Motivation - Neighborhood	0.18[d]	0.17[d]	0.09[d]	0.46[abc]	20.88[Ha]	6.67	0.000***	*G-H*
Acres of land	24.36[d]	21.21[d]	42.90	72.88[ab]	9.76[Ha]	3.51	0.017*	*G-H*
Income from land	0.04[cd]	0.0[cd]	0.33[ab]	0.33[ab]	71.44[Ha]	6.34	0.000***	*G-H*
Education	3.82[b]	2.77[ad]	3.38	3.57[b]	2.74[Ha]	2.70	0.048*	*G-H*
Occupational Sector	3.06[bd]	3.87[a]	3.26	3.58[a]	1.42[H0]	4.79	0.003**	*HSD*
Income	4.60[b]	3.26[a]	3.83	4.43	0.52[H0]	3.02	0.032*	*HSD*

*** $p < .001$, ** $p < .01$, * $p < .05$
[Ha] - unequal variance; [H0] - equal variance
Means w/ superscripts[abcd] were sig. different at $p \leq 0.05$
G-H = Games-Howell; *HSD* = Tukey Honestly Sig Difference

Pleasant Run: As identified in Chapter 3, 50% of respondents in the management area were modeled in intermix WUI communities, and this was represented in the survey sample collected (Table 4-10). Pleasant Run (x^1) residents were significantly different than Patoka River (x^3) residents in having much higher intermix communities ($x^1 = 0.50$, $x^3 = 0.16$; p = 0.013^{G-H}). Pleasant Run residents also significantly differed from Tell City (x^4) residents in their observations of prescribed fire in the community in the last year ($x^1 = 0.59$, $x^4 = 1.19$; p = 0.023^{HSD}). They also did not perceive prescribed fire as dangerously as Lost River (x^2) residents ($x^1 = 1.91$, $x^2 = 2.86$; p = 0.042^{G-H}), including their views on smoke from prescribed fire posing a threat to public health and air quality ($x^1 = 2.36$, $x^2 = 3.55$; p = 0.002^{HSD}). Pleasant Run

residents also differed significantly from Patoka River and Tell City in relying less on their land for income ($x^1 = 0.59$, $x^{3\ \&\ 4} = 0.33$; p = 0.016 & $0.001^{G\text{-}H}$). They also have significantly smaller parcels of land than Tell City residents ($x^1 = 24.36$, $x^4 = 72.88$; p = $0.023^{G\text{-}H}$). Respondents in the Pleasant Run area viewed the local economy in their respective community higher than Lost River and Patoka River residents ($x^1 = 3.34$, $x^2 = 2.48$, $x^3 = 2.53$; p = 0.007 & 0.005^{HSD}). They were also distinguished in being more affluent. Pleasant Run respondents were more highly educated ($x^1 = 3.82$, $x^2 = 2.77$; p = $0.009^{G\text{-}H}$) and earned higher incomes than Lost River residents ($x^1 = 4.60$, $x^2 = 3.26$; p = 0.05^{HSD}). There were also appreciably more respondents in the work force in this management area. Pleasant Run residents were significantly different than both Lost River and Tell City which have higher numbers of retirees ($x^1 = 3.06$, $x^2 = 3.87$, $x^4 = 3.58$; p = 0.005 & 0.04^{HSD}).

Lost River: Similar to Pleasant Run, 52% of Lost River (x^2) respondents were classified in intermix WUI communities (Table 4-10), which was significantly different than Patoka River ($x^2 = 0.52$, $x^3 = 0.16$; p = $0.028^{G\text{-}H}$). Only 29% of Lost River residents had seen or been informed of a prescribed fire being conducted on or near their property in the past, which was significantly different than Tell City ($x^2 = 0.29$, $x^4 = 0.63$; p = 0.045^{HSD}). Also, similar to Pleasant Run, residents here have heard significantly less than Tell City in the past year ($x^2 = 0.57$, $x^4 = 1.19$; p = $0.034^{G\text{-}H}$). Lost River residents had the strongest negative opinions concerning prescribed fire. They perceived prescribed fire ($x^2 = 2.86$, $x^1 = 1.91$; p = $0.042^{G\text{-}H}$) and the smoke that it generates ($x^2 = 3.55$, $x^1 = 2.36$; p = 0.002^{HSD}) as more dangerous than Pleasant Run. Similar to Pleasant Run, Lost River residents have less acreage than Tell City ($x^2 = 21.21$, $x^4 = 21.21$; p = $0.03^{G\text{-}H}$). Not a single respondent in our survey for Lost River relied on income from their land, making them significantly different than both Patoka River and Tell City respondents ($x^2 = 0.0$, $x^{3\ \&\ 4} = 0.33$; p = 0.004 & $0.000^{G\text{-}H}$). Lost River residents also viewed their community more negatively than other management area counterparts. They ranked their community quality of life ($x^2 = 3.74$, $x^4 = 4.38$; p = $0.047^{G\text{-}H}$) and crime and safety ($x^2 = 3.04$, $x^4 = 3.96$; p = $0.004^{G\text{-}H}$) significantly lower than Tell City residents. They also viewed the local economy significantly lower than Pleasant Run residents ($x^2 = 2.48$, $x^1 = 3.34$; p = 0.007^{HSD}). Lost River respondents are the least affluent of all the management areas. They ranked lower than Pleasant Run and Tell City in education; ($x^2 = 2.77$, $x^1 = 2.77$, $x^4 = 3.57$; p = 0.009 &

0.38^{G-H}), and they also ranked significantly lower in average household income than Pleasant Run as well ($x^2 = 3.26$, $x^1 = 4.6$; p = 0.05^{HSD}). Lost River also had the highest number of unemployed and disabled residents (17.4%) as well as high numbers of retirees at 43.5% making them significantly different than Pleasant Run ($x^2 = 3.87$, $x^1 = 3.06$; p = 0.005^{HSD}).

Patoka River: Patoka River (x^3) only deviatied from the rest of sample population in a few key aspects (Table 4-10). Patoka River had the lowest influence of intermix by respective management area (16%) making respondents there significantly different than Pleasant Run and Lost River ($x^3 = 0.16$, , $x^1 = 0.50$, $x^2 = 0.52$; p = 0.013 & 0.028^{G-H}). Patoka River area residents had experienced the least amount of prescribed fire near their property out of all management areas, which was significantly different than Tell City residents ($x^3 = 0.25$, $x^4 = 0.63$; p = 0.002^{G-H}). Patoka River residents are far more likely to rely on their land for financial needs than Pleasant Run and Lost River residents ($x^3 = 0.33$, $x^1 = 0.04$, $x^2 = 0.0$; p = 0.016 & 0.004^{G-H}). Similar to Lost River, Patoka River residents viewed their community more negatively than other management areas in a few key aspects. They viewed the local economy lower than Pleasant Run residents ($x^3 = 2.53$, $x^1 = 3.34$, p = 0.005^{HSD}), and respondents in Patoka River also were more concerned with the availability of affordable housing than Tell City residents ($x^3 = 3.03$, $x^4 = 3.61$; p = 0.035^{HSD}).

Tell City: Tell City residents (x^4) have the most experience when it comes to the use of prescribed fire in their community (Table 4-10). 63% of respondents had seen or been informed of a prescribed fire being conducted on or near their property which was significantly more than Lost River and Patoka River residents ($x^4 = 0.63$, $x^2 = 0.29$, $x^3 = 0.25$; p = 0.034 & 0.002^{G-H}). There also was much higher numbers of respondents which had heard of prescribed fires use in the past year making them significantly different than Pleasant Run and Lost River ($x^4 = 1.19$, $x^1 = 0.59$, $x^2 = 0.57$; p = 0.023 & 0.045^{HSD}). Tell City residents had by far the most land. Nearly 30% of respondents in this management area had more than 100 acres, and the average acreage was nearly twice the average acreage for the survey making them significantly different than residents in Pleasant Run and Lost River ($x^4 = 72.88$, $x^1 = 24.36$, $x^2 = 21.21$; p = 0.001 & 0.000^{G-H}). Like Patoka River, 33% of respondents relied on their land for income making them significantly different than Pleasant Run and Lost River ($x^4 = 0.33$, $x^1 = 0.04$, $x^2 = 0.0$; p = 0.016 & 0.004^{G-}

^{H}). Tell City residents were positive in some key aspects when it came to how they perceived their community compared to other management areas. They were significantly more positive than Lost River residents in quality of life ($x^4 = 4.38$, $x^2 = 3.74$; p = 0.047^{G-H}) as well as crime and safety ($x^4 = 3.96$, $x^2 = 3.04$; p = 0.004^{GH}). Likewise they also were significantly more likely to be motivated for moving into the area for good schools compared to Lost River ($x^4 = 0.04$, $x^2 = 0.04$; p = 0.018^{G-H}). In addition Tell City residents were more likely than all other management areas to live in the area due to their perceptions of good neighborhoods ($x^4 = 0.04$, $x^1 = 0.18$, $x^2 = 0.04$, $x^3 = 0.09$; p = 0.000^{G-H}). They were also significantly different than Patoka River residents when it came to their views on affordable housing ($x^4 = 3.61$, $x^3 = 3.03$; p = 0.035^{HSD}). Tell City ranked the highest in affluence behind Pleasant Run. 42.6% of respondents had an associate's degree or higher making Tell City residents significantly different than Lost River ($x^4 = 3.57$, $x^2 = 2.77$; p = 0.038^{GH}). Similar to Lost River there were higher numbers of retirees; 50% of Tell City respondents were retired which was the most of any management area making Lost River significantly different than Pleasant Run ($x^4 = 3.58$, $x^1 = 3.06$, p = 0.04^{HSD}).

Section 4.3 Component Analysis

The number of collected variables (questions respondents answered from the survey) is greater than the number of cases. Because this number is so high, a data reduction in SPSS 21 was needed to reduce the variables to a more manageable number before conducting our regression analysis for dependent and independent variables. There are many different methods that can be used in data reduction such as principal component, principal axis factor, maximum likelihood, generalized least squares, and unweighted least squares. There are also many different types of data rotations that can be done after the initial extraction of components/factors, including orthogonal rotations, such as varimax and equimax, which impose the restriction that the factors cannot be correlated, and oblique rotations, such as promax, which allow the components/factors to be correlated with one another.

The method used for data reduction was Principal Component Analysis using SPSS 21. Principal Components Analysis (PCA) is a variable reduction technique which maximizes the amount of variance accounted for in the observed variables by a smaller group of artificial variables called components. PCA is used when an analyst is primarily interested in reducing the observed variables into more manageable

components while maximizing the variance accounted for in the variables. PCA is predominantly used in an exploratory fashion and almost never used in a confirmatory way. It is used to identify groups of observed variables that tend to associate empirically. Unlike other data reduction methods which analyze the common variance (principal axis factor, maximum likelihood, etc.), the original matrix in a principal components analysis analyzes the total variance. Also, principal components analysis assumes that each original measure is collected without measurement error. This multivariate technique is particularly effective for Likert scale question banks; where most of the questions are associated into a generalized topic or topics. For instance; the following question about risk perception results in five variables:

Q6. For each of the following areas, how great a risk do you feel wildfires pose?

	No Risk				**High Risk**
a. Do you feel your home is at risk from wildfire?	1	2	3	4	5
b. The land adjacent to your home?	1	2	3	4	5
c. Your neighbor's property?	1	2	3	4	5
d. Your community?	1	2	3	4	5
e. The wider region?	1	2	3	4	5

From the question above, our variables can be reduced to just one component that can be a ratio/scale that behaves better in multivariate or logistic regression models. This is done by simply creating a new variable that is the mathematical mean of all the associated variables within a component. Extracted components were subjectively named to reflect the essence of variables included in each component. The component generated from the question above was named "Risk Perception". There were 12 Likert scale questions that were reduced to 19 statistically viable components[12]. Only components used in our regression analysis are discussed here for the sake of brevity.

Questions concerning wildfire's place in Indiana's landscape (Q5) were less consistent in their use for PCA. Only one component, "Negative Wildfire Perception", was extracted from this question (Table 4-11). It includes respondent's answers to questions that viewed wildfire as dangerous and/or unnecessary. This component had acceptable internal consistency and good sampling adequacy (α=

[12] In general a component is considered reliable if Eigen values (the variances of the principal components) are ≥ 1.0 and Chronbach's α (a measure of internal consistency) and Kaiser-Meyer-Olkin (KMO) (a measure of sampling adequacy) are both ≥ 0.6

0.602). Wildfire risk perception questions (Q6) were unidimensional (Table 4-12). Wildfire risk perception in particular had excellent internal consistency (α= 0.920). Because of this, wildfire risk perception was one of the dependent variables that we further explored in Section 4.3.

Table 4-11. Negative Wildfire Perception Component (Q5)

Negative Wildfire Perception - Component Matrix (N = 132)	*1*
Fire is NOT beneficial to some of Indiana's native plants, trees, and wildlife R	0.715
Fire is not necessary to maintain a natural balance in IN	0.794
Fire is dangerous to property, people, and woodlands and should be suppressed	0.704
Eigen Value	1.671
Cronbach's α Scale Reliability	0.602
KMO Measure of Sampling Adequacy	0.639
Total Variance Explained by Component	55.7%

Extraction Method: Principal Component Analysis.

R Variable recoded from original value

Table 4-12. Wildfire Risk Perception Component (Q6)

Wildfire Risk Perception - Component Matrix (N = 141)	*1*
Do you feel your neighbor's property is at risk from wildfire?	0.921
The land adjacent to your home?	0.889
Your community?	0.884
Your home?	0.864
The wider region?	0.789
Eigen Value	3.790
Cronbach's α Scale Reliability	0.920
KMO Measure of Sampling Adequacy	0.861
Total Variance Explained by Component	75.8%

Extraction Method: Principal Component Analysis.

Questions regarding ignition risks/concerns and their contribution to wildfire risk in the community yielded four components (Table 4-13). The first, "Land Management Risks", were based on questions that were associated with public/local land management as well as an associated management practice; prescribed fire. Respondents that perceived these factors as ignition risks probably are distrustful of government management of public lands. The second component, "Fuel Risks", includes questions

relating to perceived fuel ignition risks (both on public and private land). These two components (land management and fuel risks) yielded excellent internal consistency (α= 0.812 and 0.863). The third component, what we have described as "Land Use Risks", had questions associated with specific land use (α= 0.643). They include such aspects as timber harvesting, housing development, and recreational use. The final component, "Human Caused Burning"; include perceptions regarding the risk of anthropogenic ignition risks (arson and careless burning) (α= 0.649). The total variance explained by all the components in this question bank was 74%.

Table 4-13. Ignition Risk Components (Q14)

Ignition Risks - Rotated Component Matrix (N = 128)	*1*	*2*	*3*	*4*
Land Mgmt. Risks[1]				
Local management	0.858			
Public land management	0.840			
Prescribed/controlled burning	0.802			
Fuel Risks[2]				
Build-up of vegetation on public land		0.940		
Build-up of vegetation on private land		0.892		
Land Use Risks[3]				
Timber cutting practices			0.845	
Increased number of houses being built			0.745	
Recreational use on public land			0.587	
Human Caused Burning[4]				
Careless burning (brush, leaves, or trash)				0.876
Arson				0.820
Eigen Value	3.046	1.824	1.451	1.083
Cronbach's α Scale Reliability	0.812	0.863	0.643	0.649
KMO Measure of Sampling Adequacy	0.620			
Total Variance Explained by Components	74.0%			

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Strong components were generated for the questions regarding prescribed fire perception (Table 4-14). Both these Likert banks yielded two components with excellent internal consistency and sampling adequacy. The two components were split into positive and negative viewpoints respectively. Respondents that perceived prescribed fire as negative associated the management practice with wildfire and were fearful of its escape (α= 0.863). Those that viewed it positively tended to associate its use as

necessary for wildlife habitat and forests (α= 0.802). The total variance explained by the components in this question bank was 60.5%. The strongest of these components ("Negative Prescribed Fire Perception") we used as a second dependent variable for Section 4.4.

Table 4-14. Prescribed Fire Perception Components (Q25-26)

Prescribed Fire Perception - Rotated Component Matrix (N = 128)	*1*	*2*
Negative Prescribed Fire View[1]		
Prescribed fire is just as dangerous to public safety as wildfire	0.822	
I'm concerned that a prescribed fire could escape control and become a wildfire	0.775	
Prescribed burning destroys what once was a beautiful landscape	0.718	
Smoke from prescribed fire poses as much of a threat to public health and air quality as that of a wildfire	0.701	
Prescribed burning is a reckless management practice in this area because of too many negative impacts	0.565	
Positive Prescribed Fire View[2]		
Prescribed fire improves wildlife habitat, creating better opportunities for hunting		0.742
Prescribed fire is necessary for a healthy forest ecosystem		0.721
Prescribed burning is a valuable land management practice and should be widely adopted		0.711
The government should use prescribed burning as a tool whenever they see fit		0.655
Fire in the past had a much greater impact on IN's forests *(Wildfire Perception)*		0.556
My views have changed over time to be more accepting of prescribed fire in my community		0.492
Eigen Value	5.519	1.134
Cronbach's α Scale Reliability	0.863	0.802
KMO Measure of Sampling Adequacy	0.897	
Total Variance Explained by Components	60.5%	
Extraction Method: Principal Component Analysis.		
Rotation Method: Varimax with Kaiser Normalization.		

Questions concerning respondents' community participation likelihood (Table 4-15) were unidimensional. All questions in the Likert bank were included with the exception of voting participation (which is not strongly correlated with participation). This component had good internal consistency and sampling adequacy; explaining 52% of the variance (α= 0.763). A final unidimensional component that

we generated is being referred to as "Land Attachment" (Table 4-16). This component consists of respondents landowner activities such as seeking advice about the management or care of their land, enrolling land in a conservation status (such as classified forest or CRP), if they rely on their land for income, and finally if they actively manage their land. Respondents who identified that they conduct these activities might be type cast as "attached" to their land (it is not just some acreage or backyard scenery that they seldom interact with). This component had adequate internal consistency and sampling adequacy, we have chosen to include it because it explains nearly 50% of the variance (α= 0.635).

Table 4-15. Community Participation Likelihood Component (Q36)

Community Participation Likelihood - Component Matrix (N = 108)	***1***
Attended a public meeting addressing a community issue	0.795
Served as an officer in a community organization	0.783
Served on a local government committee or board	0.741
Contacted a local official about some local issue of concern	0.697
Attended a local community event or festival	0.565
Eigen Value	2.599
Cronbach's α Scale Reliability	0.763
KMO Measure of Sampling Adequacy	0.747
Total Variance Explained by Components	52.0%

Extraction Method: Principal Component Analysis.

Table 4-16. Land Attachment Component (Q36)

Land Attachment - Component Matrix (N = 127)	***1***
Have you talked with anyone or received advice on your land?	0.828
Is any of your land actively enrolled in a conservation status?	0.664
Does a portion of your income come from your property?	0.662
Do you actively manage your land?	0.606
Eigen Value	1.933
Cronbach's α Scale Reliability	0.635
KMO Measure of Sampling Adequacy	0.657
Total Variance Explained by Components	48.3%†

Extraction Method: Principal Component Analysis.

†Less than 50% of variance is explained by component

Section 4.4 Wildfire Risk Perception Model

Programs that encourage landowners to mitigate wildfire risks are receiving more attention, as fire suppression costs severely strain agency budgets. Since landowners do not bear the cost of wildfires completely, the behavior of a landowner may diverge from socially optimal decisions, and more information can reduce this gap (Amacher et al. 2005). Because of the highly settled nature of much of the greater HNF area, any wildfire in any location can immediately place homes and property at risk, no matter the size of the fire. Most respondents did not perceive a high risk to their home from wildfire (40.6%) but their views of their neighbors, the community, and region differed. Wildfire risk perception component values ranged from 0 (no risk) to 4 (high risk). What influences respondents' views and perceptions toward wildfire risk? Is there a relationship between respondents' perception and there location in the WUI (interface vs. intermix)? To accomplish this we analyzed survey responses using multiple regression in SPSS 21.

Regression analysis is probably the most commonly used statistical tool in the social sciences. It is used to evaluate relationships between two or more variables (a dependent variable and independent variables). Ordinary Least Squares (OLS) or multiple regression, is the most frequently used of all regression techniques. It is used to test causal hypotheses, to make predictions from samples of data, to derive a rate of change between variables, or to allow for multivariate analysis. When the assumptions of OLS are inviolate, multiple regression becomes the best, linear, unbiased estimator with smallest variance. We've included the following independent variables in our wildfire risk perception regression analysis:

1. **Sociodemographics**: sex, political views, and income…
2. **Children**: Perhaps having children makes survey respondents perceive the risk of wildfire higher…
3. **WUI**: Does having your home/property in interface or intermix influence survey respondents perception of wildfire risk?
4. **Housing**: Are there particular types of housing that perceive more risk (e.g mobile home vs. single family)? What impact does risk reduction activity (such as insurance) have on this…

5. **Wildfire hazard concern**: Is wildfire risk perception related to people's perceptions of wildfire as a natural disaster or forest risk?
6. **Ignition risks**: How does our generated components (fuels, human caused burning, land use, and land management) impact risk perception…
7. **Experience in wildfire**: How much does a respondent's personal experience with wildfire (whether knowing someone who has experienced one, knowing wildfire terms and organizations, or if they themselves experienced a wildfire) impact risk perception…
8. **Community participation**: Does someone who is active in their community have a higher perception of wildfire risk because they interact more with neighbors and natural resource professionals?

Before conducting a regression analysis a bivariate correlation matrix was generated using SPSS 21. This was to ensure that none of the variables exhibited higher than reasonable Pearson Correlations to avoid multicollinearity[13] problems with the data. Many of the variables are significantly correlated with wildfire risk perception. Refer to the Appendix E for our correlation matrix regarding regression models. Linear modeling in SPSS 21 was conducted to identify variables that were significant before creating a multiple regression model. Additionally, the number of cases needed for a regression analysis depends on the number of independent variables and of their expected effects (strength of relationships). If the sample is too small, only very strong relationships will be demonstrable. For this reason we only included variables in the model if they had at least 100 cases. This confers more predictive power on the rest of the population i.e. all survey respondents. The following is the most parsimonious model that we created.

We chose to utilize a hierarchical (or mixed) model to see if variables were significant continuously throughout the data. Wildfire risk perception was compared to sociodemographic independent variables (sex, children, income, and political views) in the first model. Our second model included wildfire variables (WUI, forest risks – wildfire, fuel risks, and the negative wildfire perception component). Our third model (or full model) includes insurance activity, knowledge of prescribed fire,

[13] Multicollinearity occurs when two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a non-trivial degree of accuracy.

housing type (single family, etc.) and the community participation component. Descriptive statistics for variables in our model are outlined in Table 4-17.

Table 4-17. Wildfire Risk Perception^{DV1} Model Descriptives

	Mean	SD
Wildfire Risk Perception^{Dv1}	2.24	1.03
Sex	0.60	0.49
Children	0.85	0.36
Political Views	2.56	0.95
Income	4.39	1.74
WUI (Interface/Intermix)	0.38	0.49
Forest Risks - Wildfire	2.10	1.05
Fuel Risks	2.30	1.12
Negative Wildfire Perception	2.64	0.90
Knowledge of Rx Fire	0.95	0.22
House - Type	2.18	0.39
Community Participation	1.35	0.92
Insure	0.88	0.33

N = 101

With this model, the variables predicted 52.1% of the variance, which is well within the range of many published studies (Table 4-18). The results of the multiple regression analyses show that respondents view of wildfire as a forest risk emerged as the most significant predictor of wildfire risk perception (B = 0.347, β = 0.356) followed by respondents perception of fuel risks on public and private land in their community (B = 0.277, β = 0.302). Other strong variables were house type (B = 0.801, β = 0.3) knowledge of prescribed fire (B = 1.043, β = 0.222), and interface/intermix (B = 0.453, β = 0.215). Variables that also were significant were insurance activity, sex, income, having children, negative views on wildfire, community participation, and political ideology. A linear model is outlined in Figure 4-11 comparing observed values for wildfire risk perception with our predicted values in our full model (model 3). This model does not exhibit heteroskadasticity[14], but there is strong dispersion between the dependent variable observed values and our predicted values. Variables in this model are discussed in detail in section 4.6.

[14] Heteroskedasticity refers to the circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it.

Table 4-18. Wildfire Risk Perception[DV1] Regression Coefficients

	Model 1		Model 2		Model 3	
Independent Variable	B	β	B	β	B	β
Sex[1]	-0.541**	-0.259	-0.403*	-0.193	-0.413**	-0.198
Children[2]	–	–	–	–	0.542**	0.189
Political Views[3]	–	–	–	–	0.170*	0.158
Income[4]	-0.182***	-0.308	-0.137**	-0.232	-0.113*	-0.191
WUI (Interface/Intermix)[5]			0.409*	0.194	0.453**	0.215
Forest Risks - Wildfire			0.277***	0.285	0.347***	0.356
Fuel Risks			0.323***	0.353	0.277***	0.302
Negative Wildfire Perception			0.243**	0.213	0.215*	0.188
Knowledge of Rx Fire[6]					1.043**	0.222
House - Type[7]					0.801***	0.300
Community Participation					0.185*	0.166
Insure					0.643*	0.204
Constant	2.887***		0.432		-3.577**	
R^2	0.135		0.426		0.521	

*** $p < .001$, ** $p < .01$, * $p < .05$.

[1] 0=female; 1=male

[2] 0=no children; 1=have children

[3] 1=cons. conservative; 2=most conservative; 3= moderate; 4=most liberal; 5=cons. liberal

[4] 1=<$15k; 2=$15-$25k; 3=$25-$35k; 4=$35-$50k; 5=$50-$75k; 6=$75-$100k; 7=$100-

[5] 0=interface; 1=intermix

[6] 0=none; 1=know n

[7] 2=std. house; 3=mobile house

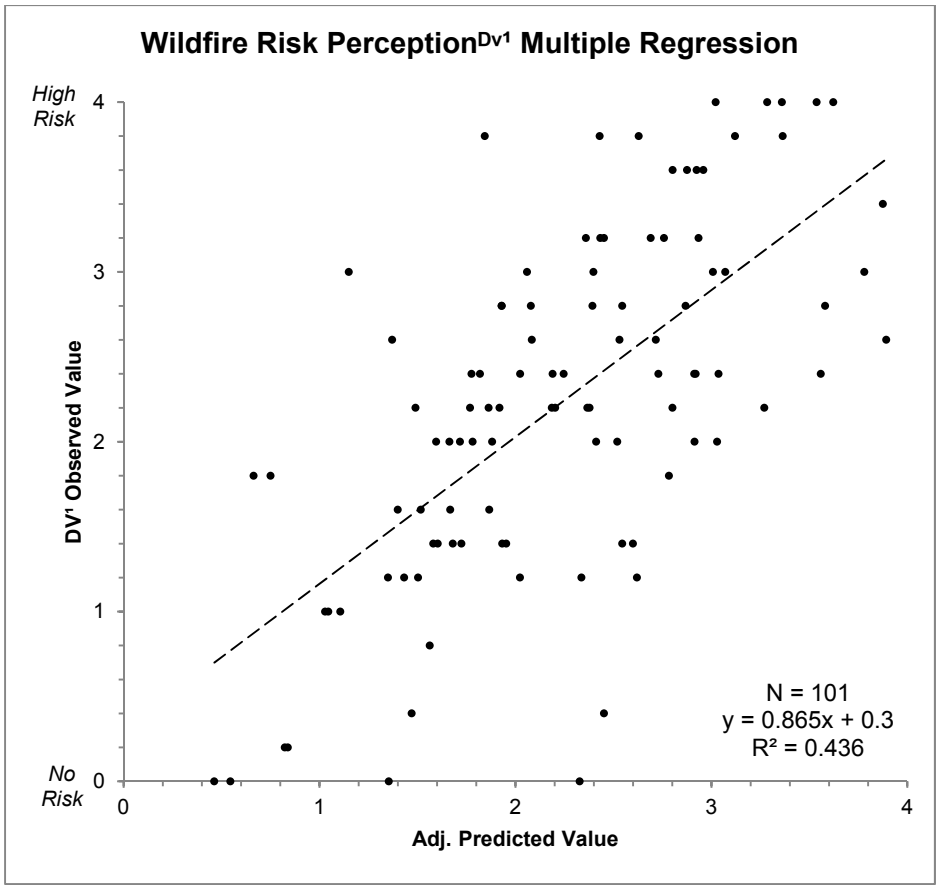


Figure 4-11. Wildfire risk perception^{DV1} multiple regression linear scatterplot

Section 4.5 Prescribed Fire Perception Model

The HNF has an active fuels management program that utilizes prescribed burning as a land management tool for many resource benefits. In the WUI, fear of liability (for damage to human health or property) could decrease the likelihood of managing wildfires for resource benefit or using prescribed fire, especially because residents incline to have negative perceptions of fire use as a management tool (Winter and Fried 2000, McCaffrey 2004, Schindler 2007). When discussing the subject of prescribed fire, adjoining landowners and the public are most concerned about health issues related to smoke or escaped fire. Therefore, it is important to land managers to communicate with the public before, during, and after a burn is conducted. To do this effectively they need to have an accurate idea of what people's perceptions are towards not only the prescribed fire itself, but also their perceptions toward how the Forest Service conducts those burns.

Most respondents were mixed in their views on prescribed fire and its use in their respective community. Many positively viewed prescribed fire as a valuable land management practice and did not view its use as reckless or its impact as negative. However as we discussed in section 4.2 regions of the WUI, such as the Lost River management area, differ in how they view the use of prescribed fire, especially the hazard that smoke generated from a prescribed fire may create. Our strongest prescribed fire perception component (negative perception) values ranged from 1 (strong positive responses) to 5 (strong negative responses). What influences respondents' views and perceptions toward prescribed fire? What makes some respondents view prescribed fire as dangerous or reckless? To accomplish this we analyzed survey responses in a multiple regression using the same methods we applied in section 4.4. We've included the following variables in our analysis:

1. **Sociodemographics**: married, years in the community …
2. **Wildfire Perception**: If you view wildfire negatively perhaps you do not distinguish between the two…
3. **Housing Proximity**: If your neighbor is close to your property boundary perhaps you'll perceive the threat of escaped fire spreading from their property to yours…
4. **Land Management Ignition Risks**: Respondents that perceived these factors as ignition risks probably are distrustful of government management of public lands…
5. **Fuel Risk**: Does a high risk perception of vegetation on public and private land influence the fear of prescribed fire?
6. **Land Attachment**: If you value your land for other reasons beyond the aesthetic (if you manage your land or rely on it for income) perhaps you do not want to see it threatened by escaped fire…
7. **Fire Should be Managed**: If you do not feel that fire should be managed for resource benefits and only suppressed as a last resort perhaps you feel the same way toward prescribed fire and its use as a management tool…

Before conducting a regression analysis a bivariate correlation matrix was generated using SPSS 21. This was to ensure that none of the variables exhibited higher than reasonable Pearson Correlations to avoid multicollinearity problems with the data. Many of the variables are significantly correlated with

prescribed fire perception. Refer to the Appendix E for our correlation matrix regarding regression models. Linear modeling in SPSS 21 was conducted to identify variables that were significant before creating a multiple regression model. The following is the most parsimonious model that we created.

We chose to utilize a simpler hierarchical model to see if variables were significant continuously throughout the data. Negative prescribed fire perception was compared to sociodemographic and locality independent variables (married, years in the community, and housing proximity) in the first model. Our second/full model included wildfire (negative wildfire perception, fuel risk, land management ignition risk, and fire should be managed) and land attachment variables. Descriptive statistics for variables in our model are outlined in Table 4-19.

Table 4-19. Negative Prescribed Fire Perception^{DV2} Descriptives

	Mean	SD
Negative Rx Fire Perception^{Dv2}	2.44	0.93
Married	0.82	0.39
Yrs in Community	35.34	21.33
Housing Proximity	2.72	0.59
Negative Wildfire Perception	2.68	0.89
Land Mgmt Ignition Risk	1.44	0.93
Fuel Risk	2.35	1.09
Land Attachment	0.35	0.29
Fire Should be Managed	3.29	1.22

N = 111

With this model, the variables predicted 59.5% of the variance, which is well within the range of many published studies (Table 4-20). The results of the multiple regression analyses in Table 4-28 show that respondents view of land management ignition risks emerged as the most significant predictor of negative prescribed fire perception (B = 0.429, β = 0.429) followed by negative wildfire perception (B = 0.288, β = 0.277). Other strong variables were land attachment (B = 0.643, β = 0.203) fires use for resource benefits (B = -0.153, β = -0.201), years in the community (B = 0.009, β = 0.195), and fuel risk (B = -0.15, β = -0.175). Variables like marriage and also housing proximity that were significant in the first model fail significance in the full model when more controls are introduced. A linear model is outlined in Figure 4-12 comparing observed values for prescribed fire perception with our predicted values in our full model (model 3). This model does appear to exhibit mild heteroskadasticity mostly due

to sparseness of higher values, but this could be simply explained by the fact that less of our respondents viewed prescribed fire negatively than those who perceived it positively. This plot also exhibits less dispersion between the dependent variable observed values and our predicted values than the wildfire risk perception model. This R^2 is strong by social science standards. Variables in this model are discussed in detail in section 4.6.

Table 4-20. Negative Prescribed Fire Perception[DV2] Regression Coefficients

	Model 1		Model 2	
Independent Variable	B	β	B	β
Married[1]	-0.549*	-0.227	–	–
Yrs in Community	0.013***	0.306	0.009**	0.195
Housing Proximity[2]	-0.336*	-0.213	–	–
Negative Wildfire Perception			0.288***	0.277
Land Mgmt Ignition Risk			0.429***	0.429
Fuel Risk			-0.15**	-0.175
Land Attachment			0.643***	0.203
Fire Should be Managed			-0.153**	-0.201
Constant	3.332***		1.863***	
R^2	0.152		0.595	

*** $p < .001$, ** $p < .01$, * $p < .05$.

[1] 0=single; 1=married

[2] 1=<25 ft; 2=25-100 ft; 3=>100 ft

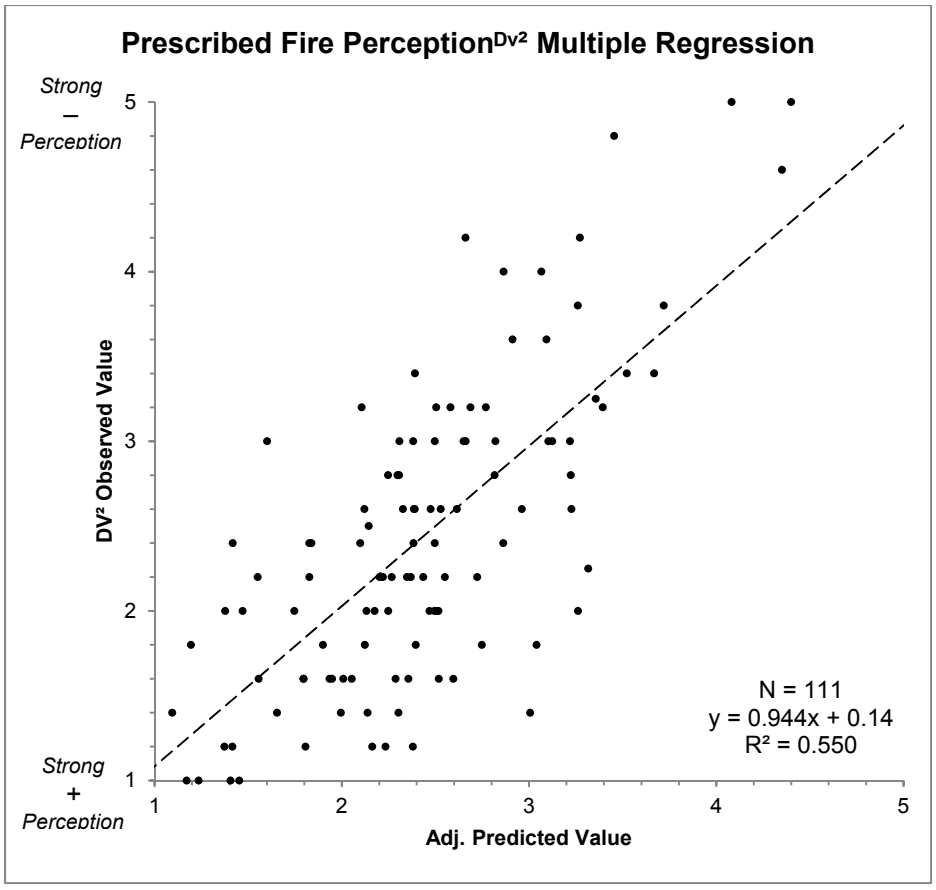


Figure 4-12. Negative prescribed fire perception^{DV2} multiple regression linear scatterplot.

Section 4.6 Discussion

Many surveys of the US household population experience high refusal rates (Dillman et al. 2009). Research has shown that nonresponse can induce bias in survey estimates, but recent empirical findings illustrate cases when the linkage between nonresponse rates and nonresponse biases is absent (Groves 2006). Additionally current research suggests that changes in nonresponse rates do not necessarily alter survey estimates (Curtin et al. 2000; Keeter et al. 2000; Merkle and Edelman 2002). While the number of returned questionnaires does not meet the target 40% response rate we selected for our sampling methodology, we still collected quality data due largely to our survey design and review process (see section 3.3). Increasing our response rate for this survey to meet the sample confidence level identified in Chapter 3 would have required a survey twice the size, which would have been logistically and

financially unfeasible. Despite low response rates, probability sampling still retains the value of unbiased sampling procedures from well-defined sampling frames (Groves 2006).

Our survey was biased towards permanent residents however. 98.3% of all survey respondents self-identified themselves as permanent residents. Less than 2% of our sample population responded as year-long seasonal residents; meaning they used the address as a second home, but still lived in the area. One positive outcome from the high amount of nondeliverable addresses was in the possible use of vacant addresses as a metric for seasonal housing. Brown County in particular had 43.8% of its addresses in this category. Far behind, but still significant, was Orange and Crawford Counties at 24.5% and 23.2%. In these three counties (Brown County in particular), seasonal houses make up a large segment of the WUI. Further research will be needed to capture their values and perception toward wildfire and prescribed fire.

Generally, WUI residents are white, near retirement age or retired, and mostly conservative in their views and beliefs. If they are working it is typically in the service sector. Most have an associate's degree or higher and have household incomes close to the median in the greater HNF area (US Census 2010). Most residents are married with no children at home, are long tenured at their current property and communities, and consider themselves "rural" (though only a minority of them actively manage their land for personal benefit). Seldom active in their community, WUI residents live in the greater HNF area for the beautiful scenery, privacy, and ties to family, local community, and the land. Most of them have a preservationist bias toward natural resources, but they strongly believe that public land in Indiana should be managed with multiple uses and that local residents should have more of a role in the decisions on that land.

Because of the highly settled nature of much of the greater HNF area, wildfire in any location can immediately place homes and property at risk, no matter the size of the fire. Risk perception has been identified as a key variable influencing mitigation behaviors such as taking action to reduce hazardous conditions, preparing for a hazardous event, or moving to a less hazardous area (Dessai et al. 2004; Grothmann and Patt 2005; Amacher et al. 2005; Niemeyer et. al. 2005; Jarrett et al. 2009; McCaffrey 2004; Fischer 2011; Winter and Fried 2000). Programs that encourage landowners to mitigate wildfire risks are receiving more attention, as fire suppression costs severely strain agency budgets. Since landowners do not bear the cost of wildfires completely, the behavior of a landowner may diverge from

socially optimal decisions, and more information can reduce this gap (Amacher et al. 2005). Most of our WUI respondents did not perceive a high risk to their home from wildfire (40.6%) but their views of their neighbors, the community, and region differed. Grand means for wildfire risk perception was slightly above moderate or some risk (2.2).

Table 4-21. Predictions for Significant Indicators of Wildfire Risk Perception

	Controlling Other Variables a Change from…		% Change in Wildfire Risk Perception
Most Influential [1]	*Wildfire as a Forest Risk* (R 0:4)	None → Extreme	*34.7%* ↑
	Fuel as an Ignition Concern (R 0:4)	None → Significant	*27.7%* ↑
	Residence Type (R 2:3)	Std. House → Mobile House	*20.0%* ↑
	Knowledge of Rx Fire (R 0:1)	None → Heard	*26.1%* ↑
	WUI (R 0:1)	Interface → Intermix	*11.3%* ↑
	Home/Property Insured (R 0:1)	No → Yes	*16.1%* ↑
	Gender (R 0:1)	Female → Male	*10.3%* ↓
	Income (R 1:8)	< $15,000 → >$150,000	*19.8%* ↓
	Have Children (R 0:1)	No → Yes	*13.6%* ↑
	Wildfire Perception (R 1:5)	Positive → Negative	*21.5%* ↑
	Community Participation (R 0:4)	None → High	*18.5%* ↑
Least Influential	*Political Views* (R 1:5)	Conservative → Liberal	*17.0%* ↑

1 Influential variables are ordered from standardized coefficients (β) in model 3 [table 4-18]

Key issues which elevated wildfire risk perception among WUI residents living in the greater HNF area were their views of wildfire as a forest risk and perceptions of fuel risks on public and private land in their community (Table 4-21). After controlling for the influence of the other variables, WUI residents who had a strong concern for wildfire as a forest risk had 35% greater wildfire risk perception. Past research suggests that homeowner's perceptions of risk are higher when vegetation on neighboring properties is perceived to be dense, thus constituting a fuel risk (Brenkert-Smith et al. 2012). Residents that had a strong concern for vegetation on public and private land were predicted to have a 28% increase

in wildfire risk perception. Other key indicators also played a role in residents' perception of risk. Living in a mobile home or trailer, having heard of prescribed fire, living in an intermix WUI condition, having insurance for their home or property, having children at home, participating in their community more, having a more negative view on wildfire, and having a more liberal than conservative outlook all increased residents perceptions of wildfire risk. Being male and having a higher household income decreased perceptions.

Some of these indicators are easier to explain than others. After controlling for the influence of the other variables, WUI residents who lived in mobile homes or trailers had 20% greater wildfire risk perception. Mobile home or trailer residents higher perceived wildfire risk is also well warranted; much research has been done regarding the added vulnerability of mobile home residents to natural hazards. Mobile homes are particularly susceptible to damage from high winds and are generally less resilient in disasters than standard housing (Bolin and Stanford 1991; Chakraborty et al. 2005; Cutter et al. 2000; Heinz Center 2000).

Beliefs about fire's catastrophic potential, sense of controllability, and cultural and social factors influence risk perceptions (Slovic 2009). If you view wildfire as dangerous and not beneficial for resource management you may perceive your personal risk to wildfire as higher than others who do not view wildfire as dangerous. Residents that had a strong negative view of wildfire (did not view it as beneficial to native vegetation or a natural balance in Indiana, and felt it should be suppressed due to the dangers posed to forests, property, and people) were predicted to have a 22% increase in wildfire risk perception. Also WUI residents exhibited differences in risk perception by which WUI condition their property and homes was segregated into. Denser wildland fuels, difficult access, scattered neighbors, less defensible space, and mixed land ownership in intermix areas (see section 3.1) can contribute to those residents higher perceived risk. All things being equal, having an intermix WUI property contributed to an 11% increase in wildfire risk perception.

Expected utility theory suggests that in the face of an uncertain outcome such as a wildfire, risk-averse individuals will place a value on avoiding such an outcome or reducing the likelihood of its occurrence either through insurance or mitigation (Winter and Fried 200). This is evidenced in our findings with WUI residents' insurance activity. Owning a policy translated to a lower tolerance for risk,

primarily due to owning property needing to be secured against the unlikely event of an accident or for liability purposes. All things being equal, having an insurance policy on their home or property contributed to a 16% increase in wildfire risk perception. Since parenting involves protecting children from various risks and dangers, a tendency towards increased risk perception and risk-averse decision-making (Eibach and Mock 2011) is exhibited more in WUI residents with children. After controlling for the influence of the other variables, WUI residents who had children were 14% more likely to perceive wildfire as a risk.

Some indicators that significantly impacted wildfire risk perception had a positive impact on risk perception. There has been substantial work in the social sciences on men being less averse to risk than women (Byrnes et al. 1999; Harris et al. 2006); this is reflected in our survey with men exhibiting lower perceptions of wildfire risk. All things being equal, being a man decreased wildfire risk perception by 10%. Upper income populations are better insulated from financial burdens that may occur in the event of natural disaster (Lynn and Gerlitz 2006). Having a higher household income may be considered by many WUI residents as a license for viewing their risk as low, if only for the sake that they have enough fiscal resources to mitigate that risk. After controlling for the influence of the other variables, WUI residents who had the highest incomes (greater than $150,000 annually) were 20% less likely to perceive wildfire as a risk.

Other significant issues associated with wildfire perception are difficult to clarify. WUI residents who had heard of prescribed fire perceived their risk substantially higher than those who had not. After controlling for the influence of the other variables, WUI residents who had heard of prescribed fire had a 26% increase in wildfire risk perception. We speculate that residents who stated they heard of prescribed fire already had preconceptions of fire as a dangerous natural hazard thanks to the introduction of this land management tool to their psyche. Those residents who did not, were ignorant to the concept, and likely ignorant to any risk posed by wildfire. Likewise it is difficult to explain why being more active in one's community can lead to higher wildfire risk perception. All things being equal, being more involved in the community increased wildfire risk perception by 19%. Past research suggests that greater social interaction with community members and participation in community events may be related to hazard awareness (Lindell and Perry 1992). WUI residents who participated more in the community (attended

public meetings, served on a committee or board, contacted an official, or attended a local event) were perhaps more aware of their neighbor's cumulative risk, and in so doing, inferred some of that risk to their own property. Finally, WUI residents who generally self-identified as more liberal than conservative perceived a higher wildfire risk. After controlling for the influence of the other variables, WUI residents were consistently liberal in their political views had a 17% increase in wildfire risk perception. Wildfire is but one of many environmental issues and Americans with liberal values have a long history of being more likely to be concerned with them than their partisan counterparts. Likewise, environmental skepticism has close ties to conservatism. More research is needed to understand how these variables impact WUI residents wildfire risk perception in the greater HNF area.

Table 4-22. Predictions for Significant Indicators of Negative Prescribed Fire Perception

	Controlling Other Variables a Change from…		% Change in Neg. Rx Fire Perception
Most Influential [1]	*Land Mgmt as an Ignition Risk* (R 1:5)	None → Significant	*42.9%* ↑
	Wildfire Perception (R 1:5)	Positive → Negative	*28.8%* ↑
	Land Attachment (R 0:1)	None → High	*16.1%* ↑
	Wildfire for Resource Benefits (R 1:5)	Disagree → Agree	*15.3%* ↓
	Yrs in Community (R 1:88)	1 yr → 88 yrs	*19.8%* ↑
Least Influential	*Fuel as an Ignition Concern* (R 0:4)	None → Significant	*15.0%* ↓

1. Influential variables are ordered from standardized coefficients (β) in model 2 [table 4-20]

The HNF has an active fuels management program that utilizes prescribed burning as a land management tool for many resource benefits. Understanding residents' perceptions toward prescribed fire and how the Forest Service conducts those burns is beneficial to the HNF. Anxieties about prescribed fire (particularly in different management areas; see section 5.2) strongly followed themes in prior research. Smoke, concerns about escape, and agency trust remain relevant issues with WUI residents in the greater HNF area (see section 2.4). Grand means for prescribed fire perception were near neutral (2.6).

The most significant indicator on why a WUI resident would view prescribed fire negatively was their views on land management ignition risks for wildfire (Table 4-22). After controlling for the influence of the other variables, WUI residents who felt that land management on public and local land

and the use of prescribed fire significantly contributed to wildfire ignition risk were 43% more likely to view prescribed fire negatively. This factors in strongly with fears of prescribed fire escaping control addressed in section 2.4. Acceptance of prescribed fire is context-specific and the shortcomings of forest managers are apparent to people who have experienced escaped prescribed fire (Brunson and Evans 2005). One of our survey respondents had actually experienced this first hand. One deterrent to restoring fire in privately owned landscapes is the perception that fire is unnatural and risky (Yoder 2008, Morton et al. 2010, Bowman et al. 2011). Residents that had a strong negative view of wildfire were predicted to have a 29% increase in negative prescribed fire perception. WUI residents who viewed wildfire in a more negative light may not distinguish between the dangers posed by wildfire and prescribed fire, and thus view its use on the landscape as unjustified. Other key indicators also played a role in residents' negative perception of prescribed fire. Land attachment and tenure in the community all increased residents negative perception, while fuel risks on public and private land in their community and opinions on wildfire's use as a beneficial management tool (suppressed as a last resort) decreased negative perception.

Residents who were more likely to seek management advice, enroll land in a conservation status, rely on their land for income, and actively manage their land were more likely to view prescribed fire negatively than those who did not or did less than more active landowners. After controlling for influence of the other variables, WUI residents were attached to their land had a 16% increase in negative prescribed fire perception. Prescribed fire is underutilized with private landowners due to concerns over liability, risk to income generated by the land, lack of training and proper equipment, and the ability to manage fires effectively (Kreuter et al. 2008; Jarrett et al. 2009; Morton et al. 2010; Harr et al. 2014). These concerns are probably warranted with WUI residents who live in the complicated private/public landscape of the greater HNF area.

Length of residence is correlated strongly with place attachment. Past work in this area suggests that long-term residence in a locale can enhance the likelihood of attachment to elements of the physical environment, as well as social attachments (Relph, 1976; Tuan, 1977). Residents who had the highest tenure in the community (some as high as 88 years) were predicted to have a 20% increase in negative prescribed fire perception. For individuals with long tenure in the community prescribed fire is a

relatively new and unproven disruption to "place", thus increasing negative perceptions of its use in the landscape.

Some indicators for prescribed fire had a positive influence. Understanding the ecological benefits of prescribed burning appears to be particularly important in shaping approval (Carpenter et al. 1986; Winter et al. 2005). WUI residents who strongly felt that fire should be managed for resource benefits and only suppressed as a last resort viewed prescribed fire use more positively than those who did not. All things being equal, residents who had the strongest positive views toward this use of wildfire were predicted to have a 15% decrease in negative prescribed fire perception. In mixed-ownership landscapes, fuels conditions on private lands have implications for fire risk on public lands and vice versa. Within the context of wildfire risk, studies in a variety of locations have found high levels of acceptance (more than 80 percent in many at-risk communities) of some use of prescribed fire to reduce fuels (Absher and Vaske 2006; Brunson 2008; Lim et al. 2009; McCaffrey 2006; McCaffrey et al. 2008; Toman and Shindler 2006; Vogt et al. 2007). This is also true among participants of this study. After controlling for the influence of the other variables, WUI residents who felt that fuels on public and private land significantly contributed to wildfire ignition risk had a 15% decrease in negative perception of prescribed fire. Higher perceived risk from fuel build up on public and private lands was associated with more positive views of prescribed fire. The higher the perceived risk of fuel build up in the landscape, the more likely prescribed fire was warranted for its reduction. It should be noted here that WUI residents in the greater HNF area typically felt that the risk was higher on public land than private which is reflective of prior research (Gordon et al. 2010; Shindler et al. 2009; Fischer 2011; Fischer and Charnley 2012). More research into WUI residents' views of public and private land and how it relates to prescribed fire's use as a management tool is needed to more effectively understand the greater HNF area.

Chapter 5 Conclusion

The WUI represents a mosaic of people, ranging from families who have owned land for generations to individuals who spend only a few weeks a year visiting a vacation home. Likewise, those communities and landscapes change over time. This research addresses perceptions of wildfire and prescribed fire among residents across public/private lands in the Hoosier region. Thesis research began with an expressed need by the HNF to better represent WUI geographic information science (GIS) data, but it has since evolved into an opportunity to research the social implications of wildfire in an often ignored region of the country.

Differences concerning community perception, motivation for living in the greater HNF area, views on prescribed fire, demographics, and land management do exist. In general a permanent HNF WUI resident is:

- white and older than the average age in the area
- married with no children at home
- tenured in the community
- considers themselves "rural"
- typically own large lot sizes
- does not actively manage their land for personal benefit
- visits public land frequently
- seldom active in their community
- opinions on their local community varies by where the resident lives
- live there primarily for beautiful scenery, privacy, and ties to family, local community, and land
- have a preservationist bias toward natural resources
- believe public land should be managed for multiple uses
- believe residents should have more of a role in decisions on public land
- inexperienced with wildfire
- inconsistent with views toward wildfire
- clear vegetation and litter around their homes; primarily due to landscaping activities

- believe reducing wildfire hazards is best left to private organizations, companies, and communities
- do not believe prescribed fire to be as dangerous as wildfire
- believe that fire is beneficial to natural areas
- feel the use of prescribed fire should be tightly controlled with public approval
- apprehensive towards the widespread adoption of prescribed fire
- views on prescribed fire are dictated somewhat by where the resident lives

The emerging concept of adaptive capacity holds that, with proper community-wide preparation, human populations and infrastructure can withstand the impacts of a wildland fire, reducing loss of life and property (Paveglio et al. 2009; Newman et al. 2013). We measured WUI residents individually for aspects of wildfire and prescribed fire. While adaptive capacity is measured primarily at the community level with a variety of other research methods (i.e. interviews, focus groups, and case studies), we have identified some aspects of HNF WUI residents that can influence adaptive capacity (Table 5-1). Little local knowledge and experience, poor community participation, few land owners with equipment and resources for dealing with large fires, fragmented ownership, and the low public perception of wildfire create a condition were people in the greater HNF area are unprepared for a large wildfire event. Adapting policies, programs and communication strategies to WUI residents within the greater HNF area will need to address the issues we have identified below. More in depth research is needed to look at the specific elements of adaptive capacity in the greater HNF area.

In general, communities in the greater HNF area exhibit characteristics most similar to a rural lifestyle WUI community as identified by Paveglio et al. (section 3.3). Rural lifestyle communities contain a diverse mix of people, including amenity migrants living in more rural areas, seeking solitude or commuting to jobs in nearby cities as well as some long-term or intergenerational residents, including farmers. Development patterns in rural lifestyle communities are more likely to feature larger lot sizes, independent people who are used to the challenges of rural living (e.g., poor roads, land clearing, fewer services), and large tracks of nearby wildlands that feature fewer landmarks or well-known parks when compared to residents in more developed communities. Residents in this archetype are not distrustful of

government, but are more likely to work on their own when dealing with local issues with little codes or standards regarding wildfire preparedness.

Table 5-1. HNF WUI Residents Responses & Elements of Adaptive Capacity

Access to & ability to adapt scientific or technical knowledge	**Interactions & relationships within the community**	**Local knowledge, resources, & skills**
18% of residents w/ BA or higher	70% of residents had not attended a public meeting in the last yr.	31% of residents managed their land
70% of residents never heard of "Firewise"	78% rarely or sometimes talked to natural resource professionals	23% of residents had personally experienced a wildfire
82% of residents never heard of "Defensible Space"	36% of residents felt they could trust the govt. to make proper decisions regarding Rx fire	30% of residents knew someone who had experienced a wildfire
	25% of residents talked to their neighbor about wildfire risk	
	70% of residents had not sought management advice concerning their land	

As we've shown in section 4.2, significant differences in WUI residents can be found between interface and intermix in the greater HNF area, and these difference should be accounted for when conducting outreach programs with residents regarding wildfire and prescribed fire management. A resident who lives in an intermix WUI condition (whose parcel is within wildland fuel); frequents public land more often, has a stronger preservationist view toward fire and natural resources, perceives slightly more wildfire risk to their home, is motivated to live in the area due in part to close outdoor amenities and recreation, is slightly more inclined to sell or give away their land soon, and is better educated. Interface residents (whose parcel borders wildland fuel) do not perceive much wildfire risk to their home, are more moderated in their opinions of fire and natural resources, visit public land less, are more likely to interact with their neighbors when it comes to discussing wildfire, and live in the greater HNF area primarily because they have strong ties to family, the local community, and the land. In general, intermix residents in the greater HNF area probably have more in common with amenity migrants which are well documented in Western states, while interface residents are more typical of Midwestern exurban communities (see section 2.2). More research is needed to further define the types of individuals that live in different WUI conditions and how their behaviors can impact management goals.

Management areas throughout the WUI differ as well. Any educational outreach in these distinct areas will need to account for residents various attitudes, beliefs, and values. WUI residents who live in the Pleasant Run management area (Brown, Monroe, Jackson, and parts of Lawrence County) are the most affluent of residents in the greater HNF area, with the highest levels of income and educational attainment. Most likely to still be working in the service sector, they tend to be primarily exurban with a mix of people in interface and intermix areas as well as the highest numbers of seasonal residents. Permanent Pleasant Run residents tend to have a positive outlook on their community and are the most accepting of prescribed fire.

Residents who live in the Lost River management area (Martin and parts of Lawrence and Orange County) are the most apprehensive of prescribed fire, being particularly more sensitive to smoke. Similar to Pleasant Run, Lost River resident tend to be primarily exurban, but higher numbers of people live in mobile homes and old towns and villages. Dominated by retirees, Lost River residents are the least affluent, are more pessimistic in their views of the community, and tend strongly toward being private.

WUI residents who live in the Tell City management area (Perry and parts of Crawford County) are substantially different in the dominance of large landowners in the community. Despite their large land holdings, few Tell City residents rely on their land for income, however it is still substantially more than intermix communities like Pleasant Run and Lost River. Residents here live primarily in interface WUI conditions, are the most experienced with prescribed fire, mostly retired, and have higher levels of education and income. Tell City residents rated their community the highest and are the most likely to live in southern Indiana for social and family reasons.

Residents in the Patoka River management area (parts of Crawford and Orange County) were distinguished in experiencing the largest housing growth. From 2000 to 2010, census block areas in the Patoka River area grew by 17%, more than twice as much as the next fastest growing area; Pleasant Run (US Census 2010). Patoka River residents are the most likely to live in interface WUI conditions and they are best thought of as an amalgamation of other management areas in the WUI. They are similar to Tell City residents in many regards; they have large parcels of land which some rely on for income, and are educated with modest incomes. Yet they also exhibit characteristics similar to Lost River residents; they view their local communities more pessimistically and tend to be more private. Finally, they have

similarities with Pleasant Run residents with high numbers of residents working in the service sector as well as seasonal residents.

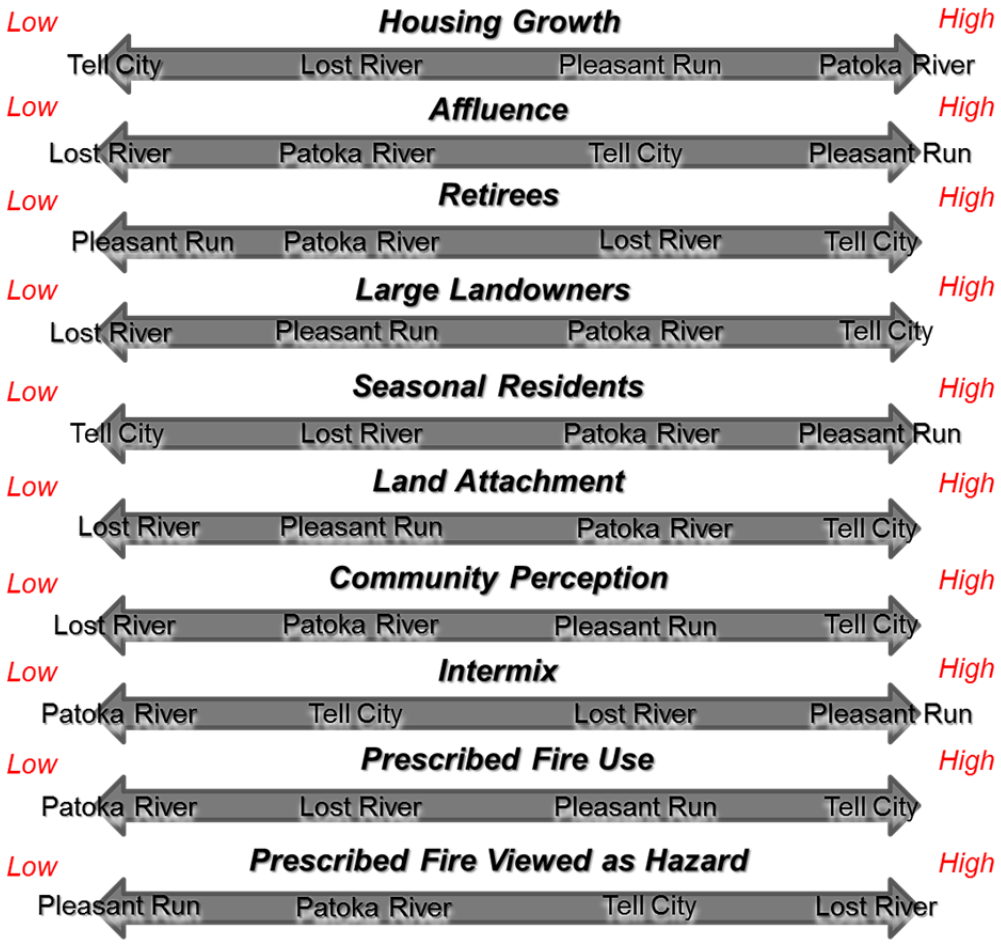


Figure 5-1. HNF management area community differences.

Wildfire as a natural hazard was viewed by many in the WUI to be similar to drought: rare and associated with hot, dry weather. Inexperienced with wildfire, many residents are inconsistent with their views toward it and the risk it poses to south-central Indiana. Respondents were mixed in activities commonly conducted by homeowners to reduce their risk to wildfire. Although they may not be familiar with the concept of defensible space, a majority of residents in the WUI reported they had cleared vegetation and litter around their home and property to reduce wildfire risk, although how much of this was just benign landscaping (with 70% of landowners considering it active management) is difficult to tell from our survey data.

Residents also appear to be misinformed when it comes to how wildfires originate as well as which ignition risks they should really be concerned about. While they were largely correct in assuming that careless burning is a significant contributor to wildfire ignitions, their lack of concern over increased development and recreational use on public land belies a lack of knowledge toward risks that are unique to the WUI. Misplaced concern toward natural processes that contribute to wildfire ignitions (drought and lightning) further contribute to unawareness of the WUI problem in the Eastern US. Because WUI residents believe reducing wildfire hazards is best left to private organizations, companies, and communities, more information and outreach concerning the nature of wildfire hazards in the greater HNF area are well warranted.

We strongly felt that perceptions of prescribed fire and wildfire in the greater HNF area were linked in some ways, and findings from our survey and statistical methods gives weight to that argument. Negative views of wildfire were linked as significant indicators in both wildfire risk perception and prescribed fire perception. Beliefs about fire's catastrophic potential, sense of controllability, and cultural and social factors influence peoples view towards fires place in a landscape. These beliefs are transferred into views on prescribed fire. WUI residents who viewed wildfire in a more negative light may not distinguish between the dangers posed by wildfire and prescribed fire, and thus view its use on the landscape as unjustified. Land managers would be wise to elaborate on the various differences between wildfire (unplanned) and prescribed fire (planned) when discussing these issues with the public.

WUI residents in general did not elevate prescribed fire to the same level of danger as a wildfire, did not perceive it as a reckless management tool, and most felt that fire was beneficial to natural areas and forests. Despite this, most residents felt the use of prescribed fire should be tightly controlled with public approval, as well as being apprehensive of its widespread adoption in the region. Smoke, concerns about escape, and agency trust remain relevant issues with WUI residents in the greater HNF area. However another significant factor emerged as an important issue when it came to residents perceptions of prescribed fire.

Residents who were more likely to seek management advice, enroll land in a conservation status, rely on their land for income, and actively manage their land were more likely to view prescribed fire negatively than those who did not or did less than more active landowners. This seems counterintuitive; it

would be assumed that landowners who manage their land more would positively view prescribed fire as a management tool, yet a negative undertone persists. This may be due to strong pre-existing dispositions toward fire being destructive as well as a general underutilization of prescribed fire on private land. When discussing prescribed fire with the public, land managers would do well at elaborating on the benefits of prescribed fire as well as alleviating any concerns to private property. Little research has been conducted on private landowner's views on prescribed fire, and more research is needed on the land attachment aspect in particular and how it is associated with perceptions.

In conclusion, we have compiled brief targets for potential outreach and education with permanent residents of the HNF. The Forest Service can use these as a general guide for interacting with the public concerning management of wildfire and prescribed fire. Our main points are…

- Outreach with residents in the greater HNF area will need to be tailored not only to the different management area communities we have identified above (Pleasant Run, Tell City, Lost River, and Patoka River), but also to different WUI conditions (interface/intermix) that people reside in.
- Residents appear to be misinformed when it comes to how wildfires originate as well as which ignition risks they should really be concerned about. Their lack of concern over increased development and recreational use on public land belies a lack of knowledge toward risks that are unique to the WUI.
- Residents are inconsistent with their views on how wildfire should be managed as well as residents' responsibilities regarding wildfire. Because WUI residents believe reducing wildfire hazards is best left to private organizations, companies, and communities, more information and outreach concerning the nature of wildfire hazards in the greater HNF area are well warranted.
- Many residents of the greater HNF area stated they cleared vegetation and litter from their property, though most never had heard of "defensible space". It would be good practice to incorporate a discussion about considering defensible space while landowners go about the landscaping and general maintenance of their property.
- Perceptions of prescribed fire and wildfire in the greater HNF area were linked. Beliefs about fire's catastrophic potential, sense of controllability, and cultural and social factors influence peoples view towards fires place in a landscape. These beliefs are transferred into views on prescribed fire. Land managers would be wise to elaborate on the various

differences between wildfire (unplanned) and prescribed fire (planned) when discussing these issues with the public.

- While many residents viewed prescribed fire positively; smoke, concerns about escape, and agency trust remain relevant issues with WUI residents in the greater HNF area. The strongest of all these factors was concerns over escaped fire. Likewise, residents who were more attached to their land were more likely to view prescribed fire negatively than less active landowners. When discussing prescribed fire with the public, land managers would do well at elaborating on the benefits of prescribed fire as well as alleviating any concerns to private property

Thesis research began with an expressed need by the HNF to better represent WUI geographic information science (GIS) data, but it has since evolved into an opportunity to research the social implications of wildfire in an often ignored region of the country. Having data at a Forest-scale resolution should be valuable to the HNF, the citizens, the local county government, and emergency managers to plan and prepare for any wildland fire incidents as well as prescribed fire by understanding *where* the WUI is. Likewise, the resulting WUI GIS data we have developed is simple and repeatable in other localities throughout the Eastern US that have complicated land use and land cover patterns as well as high densities of exurban and rural settlement. It has applicability to other regional Forests, specifically the Shawnee (IL) and the Wayne (OH).

This thesis has been immensely rewarding and challenging at the same time. As we have stated repeatedly throughout this project, no social science research analyzing fire issues specific to the WUI in South-Central Indiana has been conducted. Study outcomes will be used to help wildfire and natural resource professionals in the greater HNF area understand the social and physical complexities influencing WUI residents' perceptions and develop strategies based on research findings to build adaptive capacity among WUI residents that is specific and relevant at the local and regional level in South-Central Indiana. It is our hope that we can use findings herein to aid resource managers, citizens, and communities negotiate the myriad issues they may find when dealing with wildfire and prescribed fire in the public realm. We hope that the HNF uses the information we have provided to begin a dialog with residents and stakeholders about their wildfire risk and their views on how and why prescribed fire is used as a management tool.

Literature Cited

Absher, J.D.; Vaske, J.J. (2006). **An analysis of homeowner and agency wildland fire mitigation strategies**. In: Peden, J.G., Schuster, R.M., eds. *Proceedings of the 2005 northeastern recreation research symposium;* 2005 April 10-12; Bolton Landing, NY. Gen. Tech. Rep. NE-341. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 231-236.

Absher J.D.; Vaske, J.J. (2007). **Examining the Sources of Public Support for Wildland Fire Policies**. *Fire Management Today*, 67(1): 35-39.

Agrawal S.; Monroe, M.C. (2006). **Using and Improving Social Capital to Increase Community Preparedness for Wildfire**. In: McCaffrey S (ed) *The Public and Wildland Fire Management: Social Science Findings for Managers. General Technical Report NRS-1*. USDA Forest Service, Newton Square, PA: 163–168.

Amacher, G.; Malik, A.S.; Haight, R. (2005). **Forest landowner decisions and the value of information under fire risk**. *Canadian Journal of Forest Research*, 35(11):2603–2615.

Anderson, L.M.; Levi, D.J.; Daniel, T.C.; Dieterick, J.H. (1982). **The aesthetic effects of prescribed burning, a case study**. RN-RM-413. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 5 p.

Anderson, H.E.; Brown, J.K. (1987). **Fuel Characteristics and Fire Behavior Considerations in the Wildlands**. In: *Symposium and Workshop on Protecting People and Homes from Widlfire in the Interior West RP-SRS-12*. USDA Forest Service, Missoula, MT: 124-130.

Beale, C.L.; Johnson, K.M. (1998). **The identification of recreational counties in nonmetropolitan areas of the USA.** *Population Research and Policy Review*, 17(1): 37–53.

Berube, A.; Singer, A.; Wilson, J.H.; Frey, W.H. (2006). **Finding Exurbia: America's Fast-Growing Communities at the Metropolitan Fringe**. Brookings Institution, Washington, Living Cities Census Series.

Birdsey, R.; Pregitzer. K; Lucier, A. (2006). **Forest carbon management in the United States: 1600–2100**. *Journal of Environmental Quality*, 35: 461–1469

Bolin R.; Stanford, L. (1991). **Shelter, housing and recovery: a comparison of US disasters**. *Disasters* 15(1):24–34.

Borie, L. (1981). **Tragedy of the Mack Lake Fire**. *American Forests*. July 1981, 15-54

Bowman, D. M. J. S., J. Balch, P. Artaxo, W. J. Bond, M. A. Cochrane, C. M. D'Antonio, R. DeFries, F. H. Johnston, J. E. Keeley, M. A. Krawchuck, C. A. Kull, M. Mack, M. A. Moritz, S. Pyne, C. I. Roos, A. C. Scott, N. S. Sodhi, and T. W. Swetnam. (2011). **The human dimensions of fire regimes on earth**. *Journal of Biogeography* 38:2223-2236.

Bratkovich, S.; Gallion, J.; Leatherberry, E.; Hoover, E.; Reading W.; Durham, G. (2004) **Forests of Indiana: their Economic Importance**. Technical Paper NA-TP-02-04, Newtown Square, PA: USDA, Forest Service Northeastern Area, US Department of Commerce, Indiana Department of

Commerce, Indiana Department of Natural Resources Division of Forestry, Purdue University: 6–7.

Brenkert-Smith, H. (2006). **The place of fire**. *Natural Hazards Review*. 7(3): 105-113.

Brenkert-Smith, H.; Champ, P.A.; Flores, N. (2006). **Insights into wildfire mitigation decisions among wildland-urban interface residents**. *Society and Natural Resources*. 19(8): 759-768.

Brenkert-Smith, H. (2010) **Building Bridges to Fight Fire: The Role of Informal Social Interactions in Six Colorado Wildland-Urban Interface Communities**. *International Journal of Wildland Fire*, 19: 689–697.

Brenkert-Smith, H.; Champ, P.A; Flores, N. (2012). **Trying Not to Get Burned: Understanding Homeowners' Wildfire Risk-Mitigation Behaviors**. Environmental Management 50(6):1139-1151.

Brenkert-Smith, H.; Dickinson, K.L; Champ, P. A.; Flores, N. (2013). **Social amplification of wildfire risk: The role of social interactions and information sources**. *Risk Analysis* 33(5):800–17

Bright, A.D.; Burtz, R.T. (2006). **Creating defensible space in the wildland-urban interface: the influence of values on perceptions and behavior**. *Environmental Management*. 37(2): 170-185.

Bright, A.D.; Newman, P. (2006). **How forest context influences the acceptability of prescribed burning and mechanical thinning**. In: McCaffrey, S.M., ed. *The public and wildland fire management: social science findings for managers.* Gen. Tech. Rep. NRS-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 47-52.

Brose, P.H.; Schuler, T.M.; Ward, J.S; (2006). **Responses of Oak and Other Hardwood Regeneration to Prescribed Fire: What We Know as of 2005**. In: *Fire in Eastern Oak Forests: Delivering Science to Land Managers General Technical Report NRS-P-1*. USDA Forest Service, Newtown Square, PA: 123–135.

Brown, A.A.; Davis, K.P. (1973). **Forest Fire Control and Use**, Second Edition. McGraw-Hill, New York, NY. 686 p.

Brunson, M.W.; Shindler, B.A. (2004). **Geographic variation in social acceptability of wildland fuels management in the western United States**. *Society & Natural Resources*. 17(8): 661-678.

Brunson, M.W.; Evans, J. (2005). **Badly burned? Effects of an escaped prescribed burn on social acceptability of wildland fuels treatments**. *Journal of Forestry*. 103(3): 134-138.

Brunson, M. (2008). **Gauging the acceptability of fuels management: a matter of trust.** *Western Rural Development Center Rural Connections*. 1(3): 2-4.

Busby, G.; Albers, H.J. (2010). **Wildfire Risk Management on a Landscape with Public and Private Ownership: Who Pays for Protection?** *Environmental Management*, 45(2): 296-310.

Butler, B.J.; Leatherberry, E.C. (2004). **America's Family Forest Owners**. *Journal of Forestry*. 102(7):4-9.

Byrnes, J. P.; Miller, D.C.; Schafer, W. D. (1999). **Gender differences in risk taking: a meta-analysis**. *Psychological Bulletin.* 125: 367–383.

Cardille, J.A.; Ventura, S.J.; Turner, M.G. (2001). **Environmental and Social Factors Influencing Wildfires in the Upper Midwest, United States**. *Ecological Applications*, 11(1): 111-127.

Carman, S.F. (2013). **Indiana Forest Management History and Practices**. In: *The Hardwood Ecosystem Experiment: A Framework for Studying Responses to Forest Management. General Technical Report NRS-P-108*. USDA Forest Service, Newton Square, PA: 12–23.

Carpenter, E.H; Taylor, J.G; Cortner; H.J.; Gardner; P.D.; Zwolinski, M.J.; Daniel, T.C. (1986). **Targeting audience and content for forest fire information programs**. *The Journal of Environmental Education*. 17(3): 33-41.

Carroll, M.S.; Cohn, P.J.; Blatner, K.A. (2004). **Private and tribal forest landowners and fire risk: A two-county case study in Washington State**. *Canadian Journal of Forest Research*. 34(10):2148 –2158.

Carroll, M.S.; Higgins, L.L.; Cohn, P.J.; Burchfield, J. (2006). **Community Wildfire Events as a Source of Social Conflict**. *Rural Sociology*, 71(2): 261–280.

Chakraborty, J.; Tobin, G.A.; Montz, B.E. (2005). **Population evacuation: assessing spatial variability in geophysical risk and social vulnerability to natural hazards**. *Natural Hazards Review* 6(1):23–33.

Cleetus, R.; Mulik, K. (2014). **Playing with Fire: How Climate Change and Development Patterns are Contributing to the Soaring Costs of Western Wildfires**. *Union of Concerned Scientists* July 2014.

Cohen, J.; Saveland, J. (1997). **Structure ignition assessment can help reduce fire damages in the WUI**. *Fire Management* Notes 57(4): 19-23.

Cohen, J.D. (2000). **Preventing disaster: home ignitability in the wildland–urban interface**. *Journal of Forestry*. 98(3): 15–21.

Cohn, P.J.; Carroll, M.S.; Kumagai, Y. (2006). **Evacuation Behavior during Wildfires: Results of Three Case Studies**. *Western Journal of Applied Forestry*, 21(1): 39-48.

Cohn, P.J.; Williams, D.R.; Carroll, M.S. (2008). **Wildland-urban interface residents' views on risk and attribution**. In: Martin, W.E.; Raish, C.; Kent, B., eds. *Wildfire risk: human perceptions and management implications*. Washington, DC: Resources for the Future: 23-43.

Collins, T.W.; Bolin, B. 2009. Situating hazard vulnerability: people's negotiations with wildfire environments in the U.S. Southwest. Environmental Management. 44(3): 441-455.

Cova, T.J.; Sutton, P.; Theobald, D.M. (2004). **Exurban change detection in fireprone areas with nighttime satellite imagery**. *Photogrammetric Engineering and Remote Sensing*. 70 (11): 1249–1257.

Creswell, J.W. (1994). **Research design: Qualitative, Quantitative, and Mixed Methods Approaches**. Thousand Oaks, CA: Sage.

Croissant, C. (2004). **Landscape Patterns and Parcel Boundaries: An Analysis of Composition and Configuration of Land Use and Land Cover in South-Central Indiana**. *Agriculture, Ecosystems, and Environment*, 101: 219–232.

Curtin, R.; Presser, S.; Singer, E. (2000). **The Effects of Response Rate Changes on the Index of Consumer Sentiment**. *Public Opinion Quarterly.* 64:413-28.

Cutter, S.L.; Mitchell, J.; Scott, M. (2000). **Revealing the vulnerability of people and places: a case study of Georgetown County, South Carolina**. *Annals of the Association of American Geographers*. 90(4):713–737.

Cvetkovich, G.T.; Winter, P.L. (2008). **The experience of community residents in a fire-prone ecosystem: a case study on the San Bernardino National Forest**. Res. Pap. PSW-257. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 42 p.

Dale, V.H.; Efroymson, R.A.; Kline, K.H. (2011). **The land use–climate change–energy nexus**. *Landscape Ecology*. 26: 755–773.

Daniel, T.C. (2008). **Perceptions of Wildfire Risk**. In: Daniel TC, Carroll MS, Moseley C, Raish C (eds) *People, Fire, and Forest: A Synthesis of Wildfire Social Science*. Oregon State University Press, Corvalis: 55–69.

Deau, G.; Vogt, C.A. (2004). **The impact of wildland fire reduction techniques on attitudes toward fuels mitigation: a comparison of special use cabin permittees and other homeowners living near a national forest**. In: Murdy, J., ed. *Proceedings of the 2003 northeastern recreation research symposium*. Gen. Tech. Rep. NE-317. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 128-133.

Dether, D.; Black A. (2006). **Learning from escaped prescribed fires – lessons for high reliability**. *Fire Management Today* 66:50–56.

Dillman, D.; Smyth, J.; Christian, L. (2009). **Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method.** (3rd Edition). Hoboken, NJ: Wiley. 512 p.

Donnelly, S. (2011). **Land-use portfolios and the management of private landholdings of south-central Indiana**. *Regional Environmental Change*. 11: 97–109.

Downing, J.L.; Hodgson, R.W.; Taylor, J.G.; Gillette, S.C. (2008). **Fire Information for Communities at Risk in Interface Wildfires: Lessons Learned from the 2003 Southern California Megafires**. In: *Fire social science research from the Pacific Southwest Research Station: studies supported by National Fire Plan funds General Technical Report PSW-209.* USDA Forest Service, Albany, CA: 135-152.

Eibach, R.P.; Mock, S.E. (2011). **The vigilant parent: Parental role salience affects parents' risk perceptions, risk-aversion, and trust in strangers**. *Experimental Social Psychology.* 47(3):694-697.

Emtage, N.; Herbohn, J.; Harrison, S. (2007). **Landholder Profiling and Typologies for Natural Resource-Management Policy and Program Support: Potential and Constraints**. *Environmental Management*, 40(3): 481-92.

Fischer, A.P. (2011) **Reducing Hazardous Fuels on Nonindustrial Private Forests: Factors Influencing Landowner Decisions**. *Journal of Forestry*. 109(5): 260-266.

Fischer, A.P.; Kline, J.D.; Charnley, S.; Olsen, C. (2012). **Identifying policy target groups with qualitative and quantitative methods: The case of wildfire risk on nonindustrial private forest lands**. *Forest Policy and Economics*. 25:62–71.

Flint C.G.; Haynes R. (2006). **Managing Forest Disturbances and Community Response: Lessons from the Kenai Peninsula, Alaska**. *Journal of Forestry*. 104(3): 269-275.

Fulton,W., Pendall, R., Nguyen, M., Harrison, A., (2001). **Who sprawls the most? How growth patterns differ across the US**. The Brookings Institution, Survey Series, July 2001, 24 p.

Frontiera, P. L.; Kearns, F.R.et al. (submitted for publication). **A new approach to assessing parcel-level vulnerability to wildfire in the wildland–urban interface**. *Landscape and Urban Planning*.

Gobster, P.H. (1999). **An ecological aesthetic for forest landscape management**. *Landscape Journal*. 18: 54-64.

Gordon, J.S.; Matarrita-Cascante, D.; Stedman, R.C.; Luloff, A.E. (2010). **Wildfire perception and community change**. *Rural Sociology*. 75(3):455-477.

Gordon, J.S.; Gruver, J.B.; Flint, C.G.; Luloff, A.E. (2013). **Perceptions of Wildfire and Landscape Change in the Kenai Peninsula, Alaska**. *Environmental Management*, 52(4): 807-820.

Gude, P.; Rasker, R.; Van Den Noort, J. (2008). **Potential for future development on fire-prone lands**. *Journal of Forestry*. 106(4):198 –205.

Green, G.; Marcouiller, D.; Deller, S.; Erkkila, D.; Sumathi, N. (1996). **Land use attitudes, and economic development: Comparisons between seasonal and permanent residents**. *Rural Sociology* 61: 427-45.

Groves, R. (2006). **Nonresponse Rates and Nonresponse Bias in Household Surveys**. *Public Opinion Quarterly*. 70(5):646-675.

Guyette, R.P.; Dey, D.C.; Stambaugh, M.C. (2003). **Fire and Human History of a Barren-Forest Mosaic in Southern Indiana**. *The American Midland Naturalist*: 149:21-34.

Hammer, R.B.; Radeloff, V.C.; Fried, J.S.; Stewart, S.I. (2007). **Wildland– urban interface housing growth during the 1990s in California, Oregon, and Washington**. *International Journal of Wildland Fire* 16:255–265.

Harr, R.N.; Miller J. R.; Engle, D.M. (2012). **Quantifying eastern red cedar (Juniperus virginiana) in southern Iowa: a starting point for conversations with landowners about threats to grassland resilience**. Leopold Center for Sustainable Agriculture, Iowa State University, Ames, Iowa, USA.

Harris, C.R.; Jenkins, M.; Glaser, D. (2006). **Gender Differences in Risk Assessment: Why do Women Take Fewer Risks than Men?** *Judgment and Decision Making*. 1(1):48-63.

Haynes, R.W.; Adams, D.M.; Alig, R.J.; Ince, P.J.; Mills, J.R.; Xiaoping, X. (2007). **The 2005 RPA timber assessment update**. Gen. Tech. Rep. PNW-GTR-699 (212 pp.). Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Heckathorn, D.D. (2002). **Respondent-Driven Sampling II: Deriving Valid Estimates from Chain Referral Samples of Hidden Populations**. *Social Problems*, 49(1): 11–34.

Heimlich, R.E.; Anderson,W.D. (2001). **Development at the Urban Fringe and Beyond** (AER-803). US Department of Agriculture, Economic Research Service, Washington, DC.

Heinz Center (2000) **The hidden costs of coastal hazards: Implications for risk assessment and mitigation**. Island Press, The H. John Heinz III Center, Washington, DC

Hersperger, A. (1994). **Landscape ecology and its potential application to planning**. *Journal of Planning Literature.* 9(1): 14-30.

Hellmann, J.J.; Nadelhoffer, K.J.; Iverson, L.R.; Ziska, L.; Matthews, S.N.; Myers, P.; Prasad, A.M.; Peters, M.P. (2010). **Climate Change Impacts on Terrestrial Ecosystems in the Chicago 18 Region**. *Great Lakes Research*. 36: 74-85

Hill B.A. (2001). **The National fire plan: Federal agencies are not organized to effectively and efficiently implement the plan**. Testimony before the Subcommittee on Forests and Forest Health, Committee on Resources, House of Representatives, US General Accounting Office, GAO-10-1022T. 14 p.

Howlett, M. (2011). **Designing public policies: Principles and instruments**. Routledge, Hoboken, NJ. 256p.

Hutchinson, T. (2006). **Fire and the herbaceous layer in eastern oak forest**. P. 136-147, In *Fire in Eastern Oak Forest: Delivering Science to Land Mangers*. Dickinson, M.B. ed. USDA Forest Service, Northern Research Station, GTR-NRS-P-1.

Iverson, L.R.; Prasad, A.M.; Matthews, S.N.; Peters, M. (2008). **Estimating potential habitat for 134 eastern US tree species under six climate scenarios**. *Forest Ecology and Management*. 254, 26 390-406

Jarrett, A.; Gan, J.; Johnson, C.; Munn, I.A. (2009). **Landowner awareness and adoption of wildfire programs in the southern United States**. *Journal of Forestry*. 107(3): 113-118.

Johnson, J.F.; Bengston, D.N.; Nelson, K.C.; Fan, D.P. (2006**). Defensible space in the news: public discussion of a neglected topic**. In McCaffrey, S.M. (ed*.) The Public and Wildland Fire Management: social science findings for managers.* Gen. Tech. Rep. NRS-1. Newton Square, PA. USDA Forest Service, Northern Research Station: 169-174.

Johnson, B. E. (2008). **Nature, Affordability, and Privacy as Motivations for Exurban Living**. *Urban Geography*. 29(7): 705-723.

Johnson, B.E.; Schultz, B. (2011). **Family and Social Networks Considered in an Examination of Exurban Migration Motivations**. *The Geographical Bulletin*. 52: 39-53.

Keeter, S.; Miller, C.; Kohut, A.; Groves, R.; Presser, S. (2000). **Consequences of Reducing Nonresponse in a National Telephone Survey**. *Public Opinion Quarterly*. 64:125-48

Kent, B.; Gebert, K.; McCaffrey, S.; Martin, W.; Calkin, D.; Schuster, E.; Martin, I.; Bender, H.W.; Alward, G.; Kumagai, Y.; Cohn, P.J.; Carroll, M.; Williams, D.; Ekarius, C. (2003). **Social and economic issues of the Hayman Fire**. In: Graham, R.T., ed. *Hayman Fire Case Study*. Gen. Tech. Rep. RMRS-114. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 315-395.

Kilgore, M.A.; Snyder, S,A,; Torgerson, K.B.; Taff, S.J. (2013). **Challenges in characterizing a parcelized forest landscape: Why metric, scale, threshold, and definitions matter**. *Landscape and Urban Planning*. 110: 36– 47.

Knoot, T.G.; Schulte, L.A.; Grudens-Schuck, N.; Rickenbach, M.A. (2009). **The Changing Social Landscape in the Midwest: A Boon for Forestry and Bust for Oak?** *Journal of Forestry*. 107(5): 260– 266.

Knotek, K.; Watson, A. (2006). **Organizational characteristics that contribute to success in engaging the public to accomplish fuels management at the wilderness/non-wilderness interface**. In: Andrews, P.L.; Butler, B.W., eds. *Fuels management—how to measure success*; 2006 March 28-30, 2006; Portland, OR. Proceedings RMRS-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 703-713.

Kolaks, J.J. (2004) **Fuel Loading and Fire Behavior in the Missouri Ozarks of the Central Hardwood Region**. Masters Thesis. University of Missouri – Columbia. 115 p.

Kolaks J.J. (2013) USFS personal communication.

Krannich, R.S.; Humphrey, C.R. (1986). **Using Key Informant Data in Comparative Community Research: An Empirical Assessment.** *Sociological Methods and Research.* 14(4): 473-493.

Kreuter, U.P.; Woodard, J.B.; Taylor, C.A.; Teaugure, W.R. (2008). **Perceptions of Texas landowners regarding fire and its use**. *Rangeland Ecology and Management* 61:456-464.

Kyle, G.T.; Theodori, G.L.; Absher, J.D.; Jun, J. (2010). **The influence of home and community attachment on Firewise behavior**. *Society and Natural Resources*. 23(11): 1075-1092.

Lim, S.H.; Bowker, J.M.; Johnson, C.Y.; Cordell, H.K. (2009). **Perspectives on prescribed fire in the South: Does ethnicity matter?** *Southern Journal of Applied Forestry*. 33(1): 17-24.

Lindell, M.K.; Perry, R.W. (1992). **Behavioral Foundations of Community Emergency Management**. Washington, DC: Hemisphere Publishing Corporation.

Linder, S.H.; Peters, B.G. (1989). **Instruments of government: Perceptions and contexts**. *Journal of Public Policy*. 9(1):35–58.

Loomis, J.B.; Bair, L.S.; González-Cabán, A. (2001). **Prescribed fire and public support: knowledge gained, attitudes changed in Florida**. *Journal of Forestry*. 99(11): 18-22.

Lynn, K.; Gerlitz, W. (2006) **Mapping the Relationship between Wildfire and Poverty**. In: Andrews, Patricia L.; Butler, Bret W., comps. 2006. *Fuels Management-How to Measure Success: Conference Proceedings*. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 401-415

Mackun, P. J. (2009). **Population Change in Central and Outlying Counties of Metropolitan Statistical Areas: 2000-2007**. Washington: U.S. Census Bureau.

Mangan, R. (2007). **Wildland firefighter fatalities in the United States: 1990–2006**. Boise, ID: National Wildfire Coordinating Group, Safety and Health Working Team, National Interagency Fire Center 841: 28.

Marcouiller, D.W.; Clendenning, J.G.; Kedzior, R. (2002). **Natural Amenity-Led Development and Rural Planning**. *Journal of Planning Literature* 16(4): 515–542.

Martin, W.E.; Martin, I.M.; Kent, B. (2009). **The role of risk perceptions in the risk mitigation process: the case of wildfire in high risk communities**. *Journal of Environmental Management*. 91(2): 489-498.

Mather, A. S. (2001). **Forests of consumption: Postproductivism, postmaterialism, and the postindustrialist forest**. *Environment and Planning C: Government and Policy* 17 (2): 249-68.

McCaffrey, S. (2004). **Fighting fire with education: What is the best way to reach out to homeowners?** *Journal of Forestry*. 102(5): 12-19.

McCaffrey, S. (2006). **Prescribed fire: What influences public approval?** In: Dickinson, M.B., ed. *Fire in eastern oak forests: delivering science to land managers; proceedings of a conference*; 2005 November 15-17; Columbus, OH. Gen. Tech. Rep. NRS-P-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 192-198.

McCaffrey, S. (2008). **Understanding public perspectives of wildfire risk**. In: Martin, W.E.; Raish, C.; Kent, B., eds. *Wildfire risk: human perceptions and management implications*. Washington, DC: Resources for the Future: 11-22.

Medley, K.E.; Pickett, S.T.A.; Mcdonnell, M.J. (1995). **Forest-landscape structure along an urban-to-rural gradient**. *Professional Geographer*.47:159 –168.

Mercer, D.; Prisbey, D. (2004). **Vigilant geography: Newspaper coverage of a wildfire at the Hanford Nuclear Site**. *Environmental Practice*. 6(3): 247-256.

Merkle, D.; Edelman, M. (2002). **Nonresponse in Exit Polls: A Comprehensive Analysis**. In .*Survey Nonresponse*. ed. Robert M. Groves, Don A. Dillman, John L. Ellinge, and Roderick J. A. Uttle. pp. 243-58. New York: Wiley.

Merrick M.; Vining, J. (2006). **Characteristics People Consider when Evaluating Forest Landscape Attractiveness: Fuel Management Implications**. In: McCaffrey S (ed) *The Public and Wildland Fire Management: Social Science Findings for Managers.* General Technical Report NRS-1. USDA Forest Service, Newton Square, PA: 63–75.

Monroe, M.C.; Nelson, K.C.; Payton, M. (2006). **Communicating with Homeowners in the Interface about Defensible Space**. In: McCaffrey SM (ed) *The Public and Wildland Fire Management: Social Science Findings for Managers. General Technical Report NRS-1*. USDA Forest Service, Newton Square, PA: 99–110.

Morton, L.W.; Regan, E.; Engle, D.M.; Miller, J. R.; Harr R.N. (2010). **Perceptions of landowners concerning conservation, grazing, fire, and eastern redcedar management in tallgrass prairie**. *Rangeland Ecology & Management* 63:645-654.

Mundell, J.; Taft, S.J.; Kilgore, M.A.; Snyder. (2010). **Using Real Estate Records to Assess Forest Land Parcelization and Development: A Minnesota Case Study**. *Landscape and Urban Planning*, 94(2): 71–76.

Murname, R. J. (2006). **Catastrophe risk models for wildfires in the wildland–urban interface: What insurers need**. *Natural Hazards Review*, 7(4): 150–156.

Nation, R.F., (2005). **At Home in the Hoosier Hills**. Indiana University Press, Bloomington, IN.

Nelson, P.B. (1997). **Migration, sources of income, and community change in the nonmetropolitan Northwest**. *Professional Geographer* 49(4): 418-30.

Nelson, A.C.; Sanchez, T.W. (1999). **Debunking the Exurban Myth: A Comparison of Suburban Households.** *Housing Policy Debate*, 10(3): 689-709.

Nelson, K.C.; Monroe, M.C.; Johnson, J.F.; Bowers, A. (2004). **Living with fire: homeowner assessment of landscape values and defensible space in Minnesota and Florida, USA**. *International Journal of Wildland Fire*. 13(4): 413-425.

Nelson, K.C.; Monroe, M.C.; Johnson, J.F. (2005). **The look of the land: homeowner landscape management and wildfire preparedness in Minnesota and Florida**. *Society and Natural Resources*. 18(4): 321-336.

Newman, S.M.; Carroll, M.S.; Jakes, P.J.; Paveglio, T.B. (2013). **Land Development Patterns and Adaptive Capacity for Wildfire: Three Examples from Florida**. *Journal of Forestry*. 111(3):167–174.

Nowacki, G.J.; Abrams, M.D. (2008). **The Demise of Fire and "Mesophication" of Forests in the Eastern United States**. *BioScience* 58(2): 123-138.

Patey, R.C.; Evans, R.M. (1979). **Identification of scenically preferred forests landscapes**. P. 532-538, In Proceedings of *Our National Landscape: A Conference on Applied Techniques for Analysis and Management of the Visual Resource*. Elsner, G.H., and R.C. Smardon, eds. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station. GTR-PSW-35

Paveglio, T.B.; Jakes, P.J.; Carroll, M.S.; Williams, D.R. (2009). **Understanding Social Complexity within the Wildland-Urban Interface: A New Species of Human Habitation?** *Environmental Management*, 43(6): 1085-95.

Paveglio, T.B.; Carroll, M.S.; Jakes, P.J. (2010). **Alternatives to evacuation during wildland fire: Exploring adaptive capacity in one Idaho community.** *Environmental Hazards Human and Policy Dimensions*. 9(4):379 –394.

Paveglio, T.B.; Carroll, M.S.; Jakes, P.J.; Prato, T. (2012). **Exploring the social characteristics of adaptive capacity to wildfire: Insights from Flathead County, Montana**. *Human Ecology Review*. 19(2):110 –124.

Paveglio, T.B.; Moseley, C; Carroll, M.S.; Williams, D.R.; Davis, E.J.; Fischer, A.P. (2015). **Categorizing the Social Context of the Wildland Urban Interface: Adaptive Capacity for Wildfire and Community "Archetypes"**. *Forest Science*, 61(2): 298–310.

Parkinson, T.M.; Force, J.E.; Smith, J.K. (2003). **Hands-on learning: its effectiveness in teaching the public about wildland fire**. *Journal of Forestry*. 101(7): 21-26.

Perry, C.D.; Vellidis, G.; Lowrance, R.; Thomas, D.L. (1999). **Watershed-Scale Water Quality Impacts of Riparian Forest Management**. *Journal of Water Resource Planning Management*, 125(3): 117–125.

Platt, R.V. (2006). **A model of exurban land-use change and wildfire mitigation**. *Environmental Planning. B Planning Design.* 33:749 –765.

Quinn-Davidson, L.N.; Varner, J.M. (2012). **Impediments to prescribed fire across agency, landscape and manager: an example from northern California**. *International Journal of Wildland Fire* 21: 210–18.

Radeloff, V.C.; Hammer, R.B.; Stewart, S.I.; Fried, J.S.; Holcomb, S.S.; McKeefry, J.F. (2005). **The Wildland-Urban Interface in the United States**. *Ecological Applications*. 15(3): 799-805.

Reich, P.B. (2011). **Taking stock of forest carbon**. *Nature Climate Change*. 1, 346–347

Relph, E. (1976). **Place and placelessness**. London: Pion Limited.

Ribe, R.G. (1990). **A general model for understanding the perception of scenic beauty in northern hardwood forests**. *Landscape Journal*. 9(2): 86-101.

Robertson, P.A.; Heikens, A.L. (1994). **Fire frequency in oak-hickory forests of southern Illinois**. *Castanea* 59:286-291.

Rodriguez-Mendez, S.; Carroll, M.S.; Blatner, K.A.; Findley, A.J.; Walker, G.B.; Daniels, S.E. (2003). **Smoke on the Hill: A Comparative Study of Wildfire and Two Communities**. *Western Journal of Applied Forestry*. 18(1): 60–70.

Rogers, S.C.; Hoover, W.L.; Allred, S.B. (2013). **Indiana Residents' Perceptions of Woodland Management.** In: *The Hardwood Ecosystem Experiment: A Framework for Studying Responses to Forest Management.* General Technical Report NRS-P-108. USDA Forest Service, Newton Square, PA: 254–286.

Ryan, R.L. (2005). **Social science to improve fuels management: a synthesis of research on aesthetics and fuels management**. GTR-NC-261. St. Paul, MN: USDA Forest Service, North Central Research Station. 58p.

Ryan, R.L.; Wamsley, M.B.; Blanchard, B.P. (2006). **Perceptions of wildfire threat and mitigation measures by residents of fire-prone communities in the Northeast: survey results and wildland fire management implications**. In: McCaffrey, S.M., ed. *The public and wildland fire management: social science findings for managers*. Gen. Tech. Rep. GTR-NRS-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 11-17.

Ryan, R.L. (2010). **Local residents' preferences and attitudes toward creating defensible space against wildfire in the Northeast Pine Barrens**. *Landscape Journal*. 29(2): 199-214.

Schneider, A.; Ingram, H. (1990). **Behavioral assumptions of policy tools**. *Journal of Politics*. 52(2): 510–529.

Schulte, S.; Miller, K.A. (2010). **Wildfire risk and climate change: the influence on homeowner mitigation behavior in the wildland-urban interface**. *Society and Natural Resources*. 23(5): 417-435.

Scott, J.H.; Burgan, R.E. (2005). **Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermal's Surface Fire Spread Model**. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

Singer, E. (2008). **Ethical issues in surveys**. In E. D. de Leeuw, J. J. Hox, & D. A. Dillman (Eds.), *International handbook of survey methodology* (pp. 78-96). New York/London: Lawrence Erlbaum Associates.

Singh R.; Petroni R.J.; Allen T.M. (1994). **Oversampling in Panel Surveys. Sample Design and Weighting Research in Panel Surveys**. In: *Proceedings of the Survey Research Methods Section*, American Statistical Association. 674-679.

Shafran, A.P. (2008) **Risk externalities and the problem of wildfire risk**. *Journal of Urban Economics.* 64(2): 488-495.

Shands, W.E.(1992). **The Lands Nobody Wanted: The Legacy of the Eastern National Forests**. in *Origins of the National Forests: A Centennial Symposium*. Steen, Harold K., ed. Durham, NC: Forest History Society.

Shindler, B.A.; Toman, E.; McCaffery, S.M. (2009). **Public Perspectives of Fire, Fuels and the Forest Service in the Great Lakes Region: A Survey of Citizen–Agency Communication and Trust**. *International Journal of Wildland Fire*, 18: 157–164.

Shindler, B.; List, P.; Steel, B.S. (1993). **Managing federal forests: public attitudes in Oregon and nationwide**. *Journal of Forestry*, 91(7): 36–42.

Shindler, B.; Reed, M.; Kemp, B.; McIver, J. (1996). **Forest management in the Blue Mountains: Public perspectives on prescribed fire and mechanical thinning**. Corvallis, OR: Dept of Forest Resources, Oregon State University.

Slovic, P. (2009). **The perception of risk**. *Earthscan* Publications Limited, Sterling, Virginia, USA.

Spain, D. (1993). **Been-heres versus come-heres: Negotiating conflicting community identities**. *Journal of the American Planning Association.* 59 (2): 156-71.

Stambaugh, M.C.; Marshchall, J.M.; Guyette, R.P. (2010). **Developing Fire Histories for the Eastern U.S. Final Project Report** (JFSP Project Number: 06-3-1-16). May 10, 2010.

Stein, S.M.; Alig, R.J; White, E.M; Comas, S.J; Carr, M.; Eley, M.; Elverum, K.; O'Donnell, M.; Theobald, D.M.; Cordell, K.; Haber, J.; Beauvais, T.W. (2007). **National forests on the edge: development pressures on America's national forests and grasslands**. Gen. Tech. Rep. PNWGTR- 728. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Stewart, S.I.; Wilmer, B.; Hammer, R.B.; Aplet, G.H.; Hawbaker, T.J.; Miller, C.; Radeloff, V.C. (2009). **Wildland–Urban Interface Maps Vary with Purpose and Context**. *Journal of Forestry*, 107(2): 78-83.

Sturtevant, B.R.; Jian Yang, M.; Hong, S.H.; Gustafson, E.J.; Scheller, R.M. (2009). **Studying Fire Mitigation Strategies in Multi-Ownership Landscapes: Balancing the Management of Fire-Dependent Ecosystems and Fire Risk**. *Ecosystems*, 12(3): 445-461.

Swanston, C.; Janowiak, M.; Iverson, L.; Parker, L.; Mladenoff, D.; Brandt, L.; Butler, P.; St. Pierre, M.; Prasad, A.M.; Matthews, S.; Peters, M.; Higgins, D. (2011). **Ecosystem vulnerability assessment and synthesis: a report from the Climate Change Response Framework Project in northern Wisconsin.** 142 pp

Taylor, J.G.; Daniel, T.C. (1984). **Prescribed fire: public education and perception**. *Journal of Forestry*. 82: 361-365.

Thomas, D.S.; Butry, D.T. (2014). **Areas of the U.S. Wildland Urban Interface Threatened by Wildfire During the 2001-2010 Decade**. *Natural Hazards*. 71: 1561–1585.

Theobald, D.M.; Romme, W. (2007). **Expansion of the US wildland– urban interface**. *Landscape and Urban Planning*. 83:340 –354.

Theobald, D.M. (2001). **Land use dynamics beyond the American urban fringe**. *Geography Review.* 91: 544–564.

Thorne, S.; Sundquist, D. (2001). **New Hampshire's Vanishing Forests: Conversion, Fragmentation, and Parcelization of Forests in the Granite State**. *Society for the Protection of New Hampshire Forests*, Concord, NH. 153p.

Toman, E.; Shindler, B. (2006). **Wildland fire and fuel management: principles for effective communication**. In: McCaffrey, S.M., ed. *The public and wildland fire management: social science findings for managers*. Gen. Tech. Rep. NRS-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 111-123.

Toman, E.; Stidham, M.; McCaffrey, S.; Shindler, B. (2013). **Social Science at the Wildland-Urban Interface: a Compendium of Research Results to Create Fire-Adapted Communities**. Gen. Tech. Rep. NRS-111. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 75 p.

Toman, E.; Stidham, M.; Shindler, B.; McCaffrey, S. (2011). **Reducing fuels in the wildland urban interface: community perceptions of agency fuels treatments**. *International Journal of Wildland Fire*. 20(3): 340-349.

Tuan, Y.F. (1980). **Rootedness versus sense of place**. *Landscape*. 24: 3-8.

USFS, BIA, BLM, USFWS, and NPS Notice of Action: (2001) **Urban Wildland Interface Communities within the Vicinity of Federal Lands that are at High Risk from Wildfire**. *66 FR 751*. Doc. 01–52.

Vining, J. (2004). **Public attitudes toward forest management in an Illinois national forest**. *Journal of Environmental Systems*, 30(2): 147–157.

Vining, J.; Merrick, M.S. (2008). **The influence of proximity to a National Forest on emotions and fire-management decisions**. *Environmental Management*. 41(2): 155-167.

Vogt, C.; Winter, G.; McCaffrey, S. (2007). **Community views of fuels management: Are National Forest local recreation users more supportive?** In: Burns, R.; Robinson, K., eds. *Proceedings of the 2006 northeast recreation research symposium*; 2006 April 9-11; Bolton Landing, NY. Gen. Tech. Rep. NRS-P-14. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 546-550.

Weber, M.G.; Taylor, S.W. (1992). **The use of prescribed fire in the management of Canada's forested lands**. *Forest Chronology.* 68:324–34.

Weisshaupt, B.R.; Carroll, M.S.; Blatner, K.A.; Robinson, W.D.; Jakes, P.J. (2005). **Acceptability of smoke from prescribed forest burning in the northern inland west: a focus group approach.** *Journal of Forestry*. 103(4): 189-193.

Weisshaupt, B.R.; Jakes, P.J.; Carroll, M.S.; Blatner, K.A. (2007). **Northern inland west land/homeowner perceptions of fire risk and responsibility in the wildland-urban interface**. *Human Ecology Review*. 14(2): 177-187.

Welch, D.; Croissant, C.; Evans, T.; Ostrom, E. (2001). **A Social Assessment of Hoosier National Forest**. CIPEC Summary Report No. 3. Bloomington: Center for the Study of Institutions, Population, and Environmental Change (CIPEC), Indiana University.

Williams, C.A.; Collatz, G.J.; Masek, J.; Goward, S.N. (2012): **Carbon consequences of forest disturbance and recovery across the conterminous United States**. *Global Biogeochemistry Cycles*. 26(2) 1005.

Wilmer, B.; Aplet, G. (2005). **Targeting the community fire planning zone: Mapping matters**. *The Wilderness Society*, Washington, DC.

Winter, G.; Fried, J.S. (2000). **Homeowner Perspectives on Fire Hazard, Responsibility, and Management Strategies at the Wildland-Urban Interface**. *Society and Natural Resources*, 13(1): 33-49.

Winter, G.; Vogt, C.A.; McCaffrey, S. (2004). **Examining social trust in fuels management strategies**. *Journal of Forestry*. 102(6): 8-15.

Winter, G.; Vogt, C.; McCaffrey, S.M. (2005). **Community views of fuels management on the Mark Twain National Forest and comparisons to other study sites**. Survey Data Report. Prepared for North Central Research Station, USDA Forest Service.

Winter, P.L.; Cvetkovich, G.T. (2008). **Diversity in southwesterners' view of Forest Service fire management**. In: Martin, W.E.; Raish, C.; Kent, B., eds. *Wildfire risk: human perceptions and management implications*. Washington, DC: Resources for the Future: 156-170.

Winter, G.; McCaffrey, S.; Vogt, C.A. (2009). **The Role of Community Policies in Defensible Space Compliance**. *Forest Policy and Economics*, 11: 570–578.

Wade, D.D.; Lungsford, J.D.; (1989). **A guide for prescribed fire in southern fores**t. R8-TP11. Atlanta, GA: USDA Forest Service, Southern Region. 56 p.

Woodall, C.W.; Perez, J.A.; Thake, T.R. (2007). **Forest Resources of the Hoosier National Forest 2005**. Resource Bulletin NRS-18. USDA Forest Service, Newtown Square, PA: 3–9.

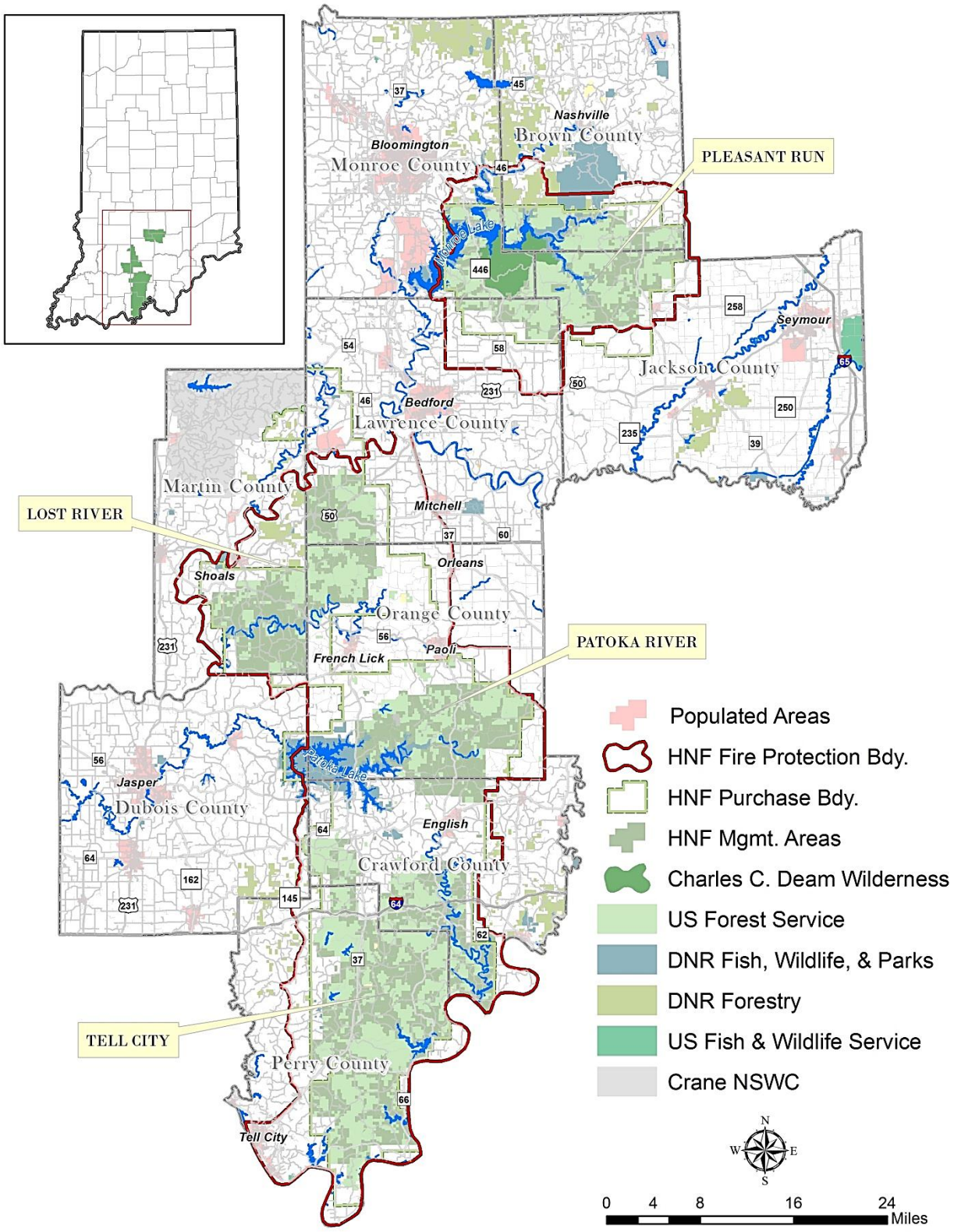
Yoder, J. (2008). **Liability, regulation, and endogenous risk: the incidence and severity of escaped prescribed fires in the United States**. *Journal of Law & Economics* 51:297-325.

York, A.M.; Munroe, D.K. (2010). **Urban Encroachment, forest regrowth, and land use institutions: Does zoning matter?** *Land Use Policy*. 27(2): 471–479.

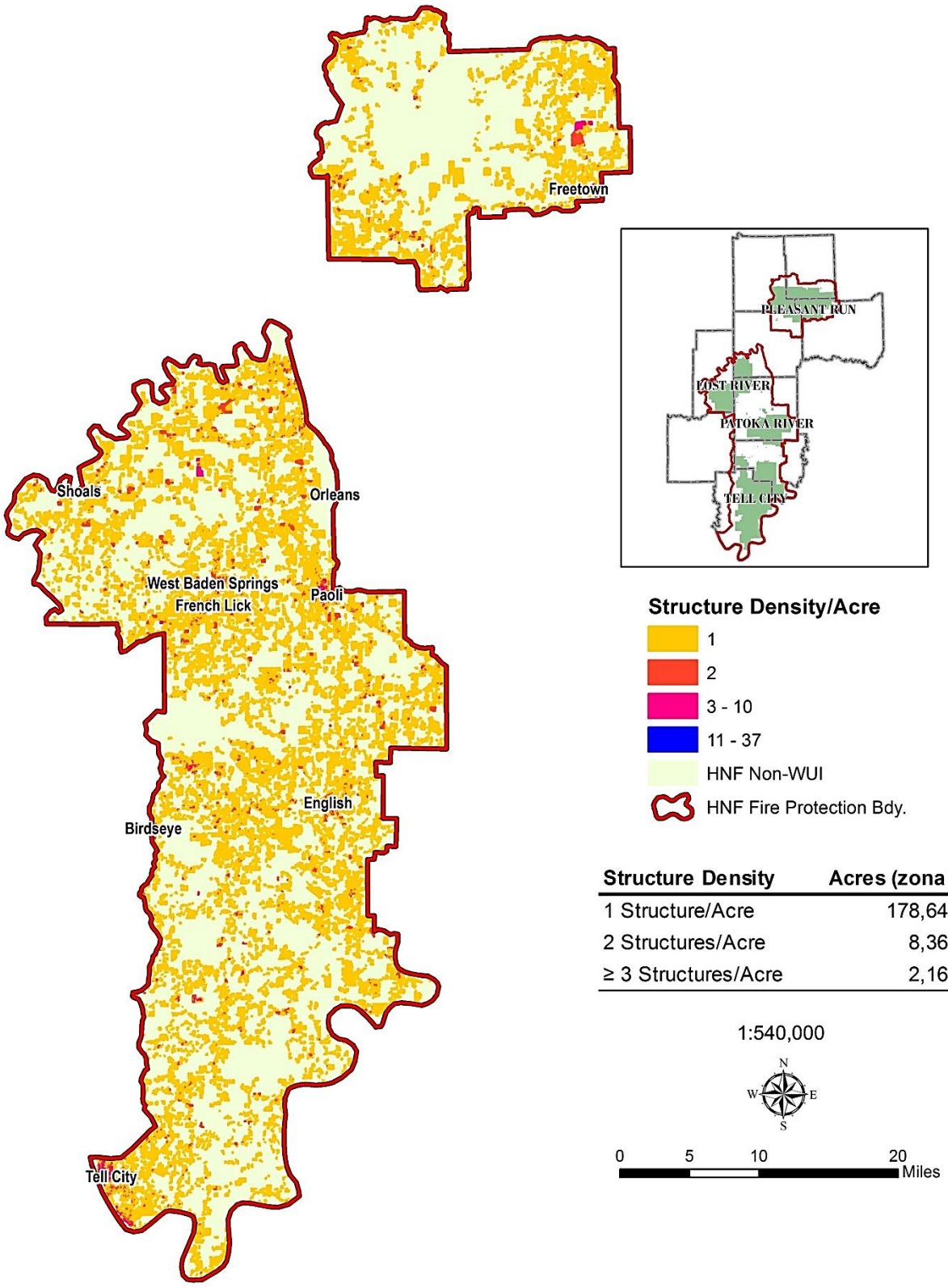
Zipperer, W.C.; Birch, T.W. (1993). **Forest Land Ownership Patterns**. *New York New Jersey Highlands Regional Study: Analysis of Selected Resources.* USFS NA-TP-04-93, USFS Northern Area State and Private Forestry and Northern Forest Experimental Station, Washington, DC. 87 p.

APPENDICES

Appendix A - Maps

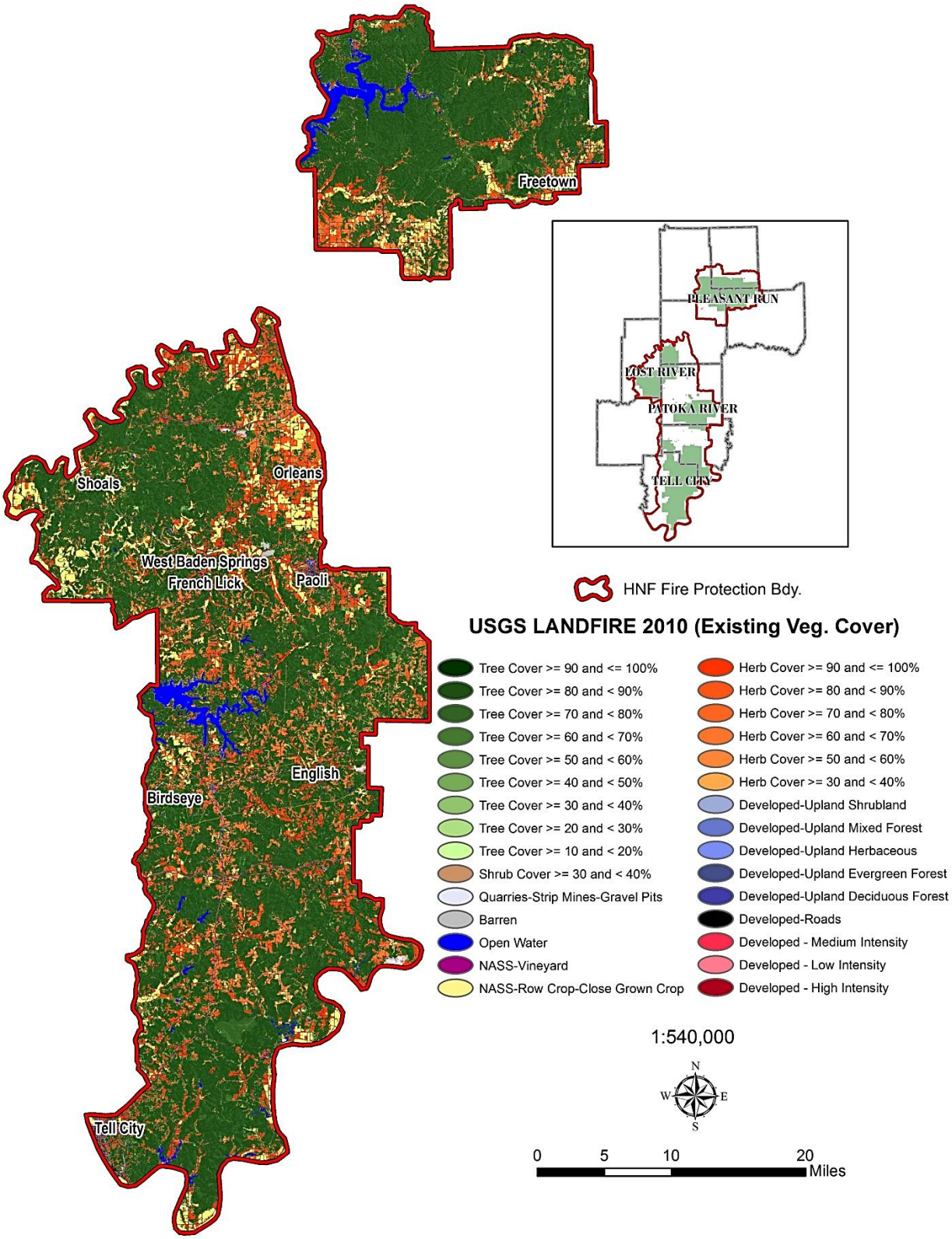


Map 2-1. Greater Hoosier National Forest Area.

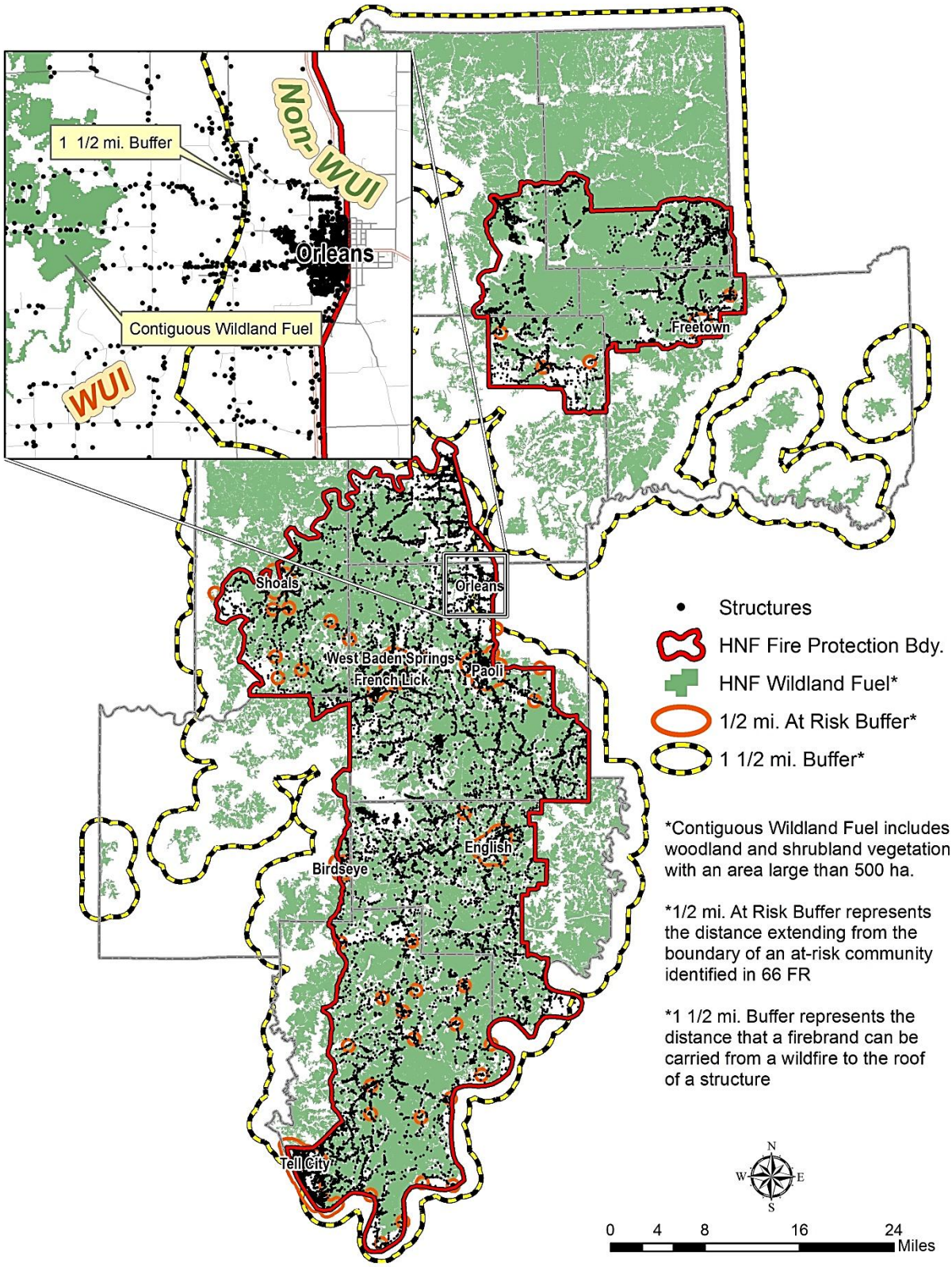


Structure Density	Acres (zonal)
1 Structure/Acre	178,644
2 Structures/Acre	8,366
≥ 3 Structures/Acre	2,166

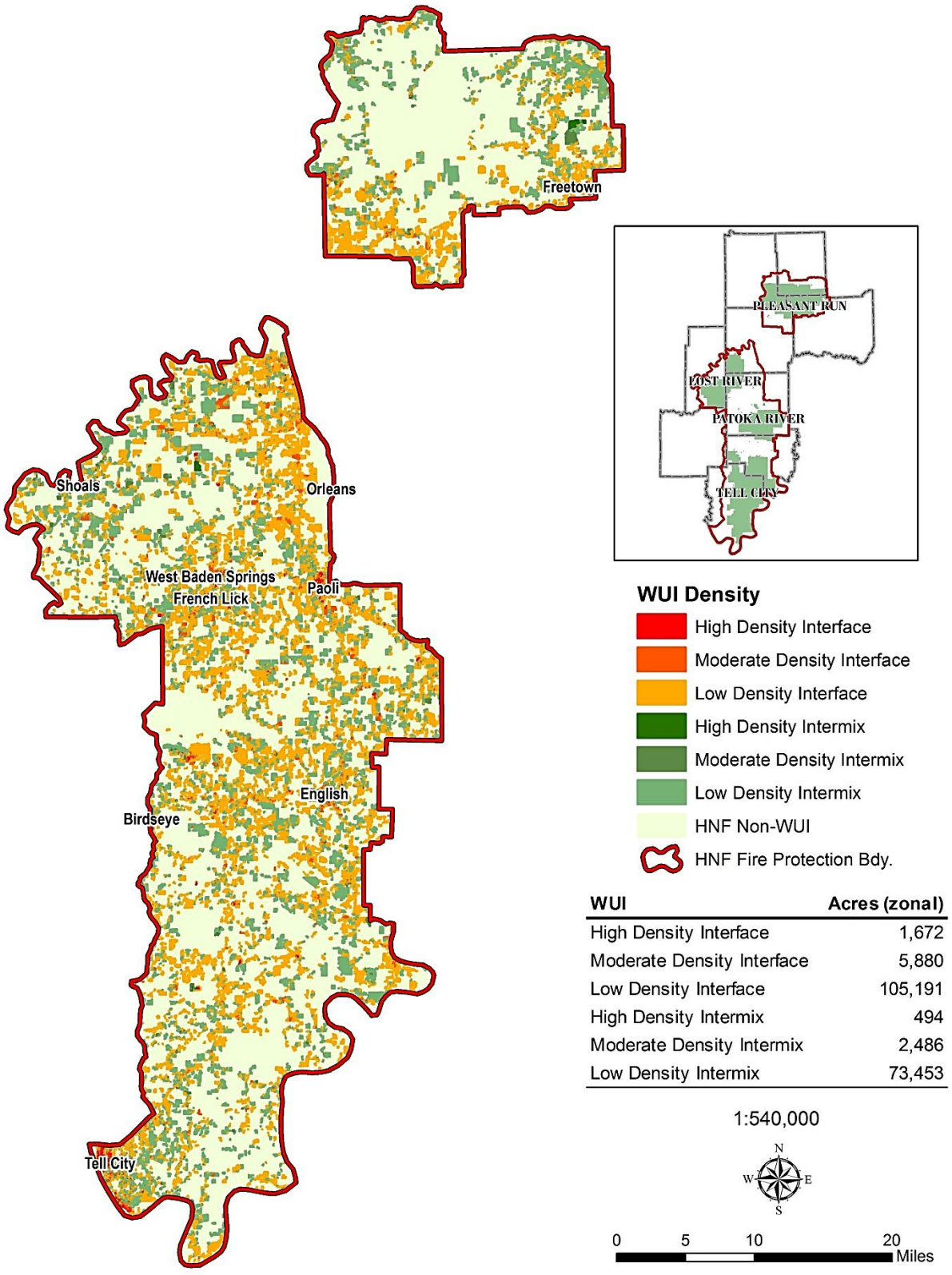
Map 3-1. HNF WUI Structure Density (Zonal Data).



Map 3-2. HNF USGS LANDFIRE Existing Vegetation Cover (2010).

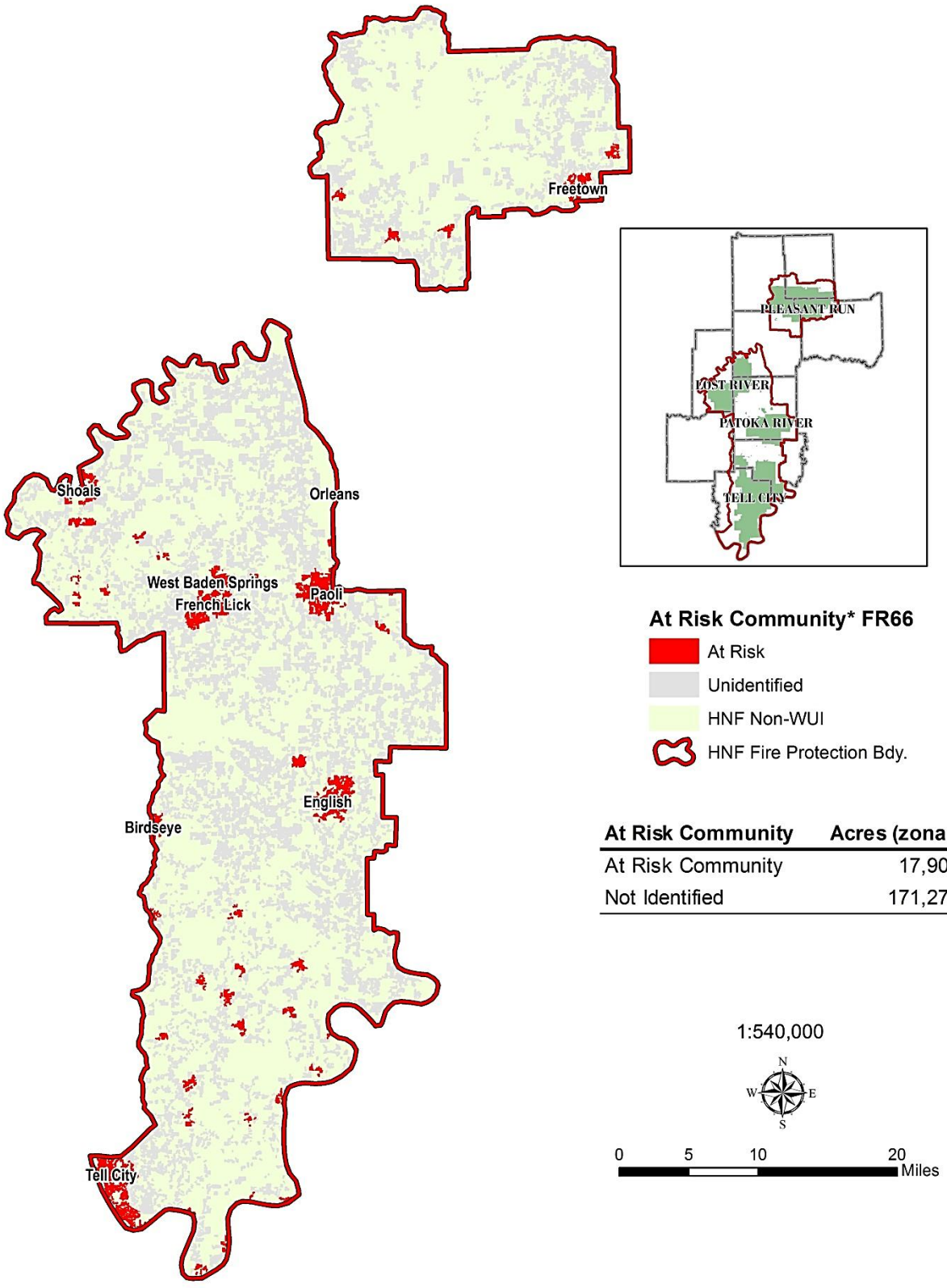


Map 3-3. HNF WUI Definition.



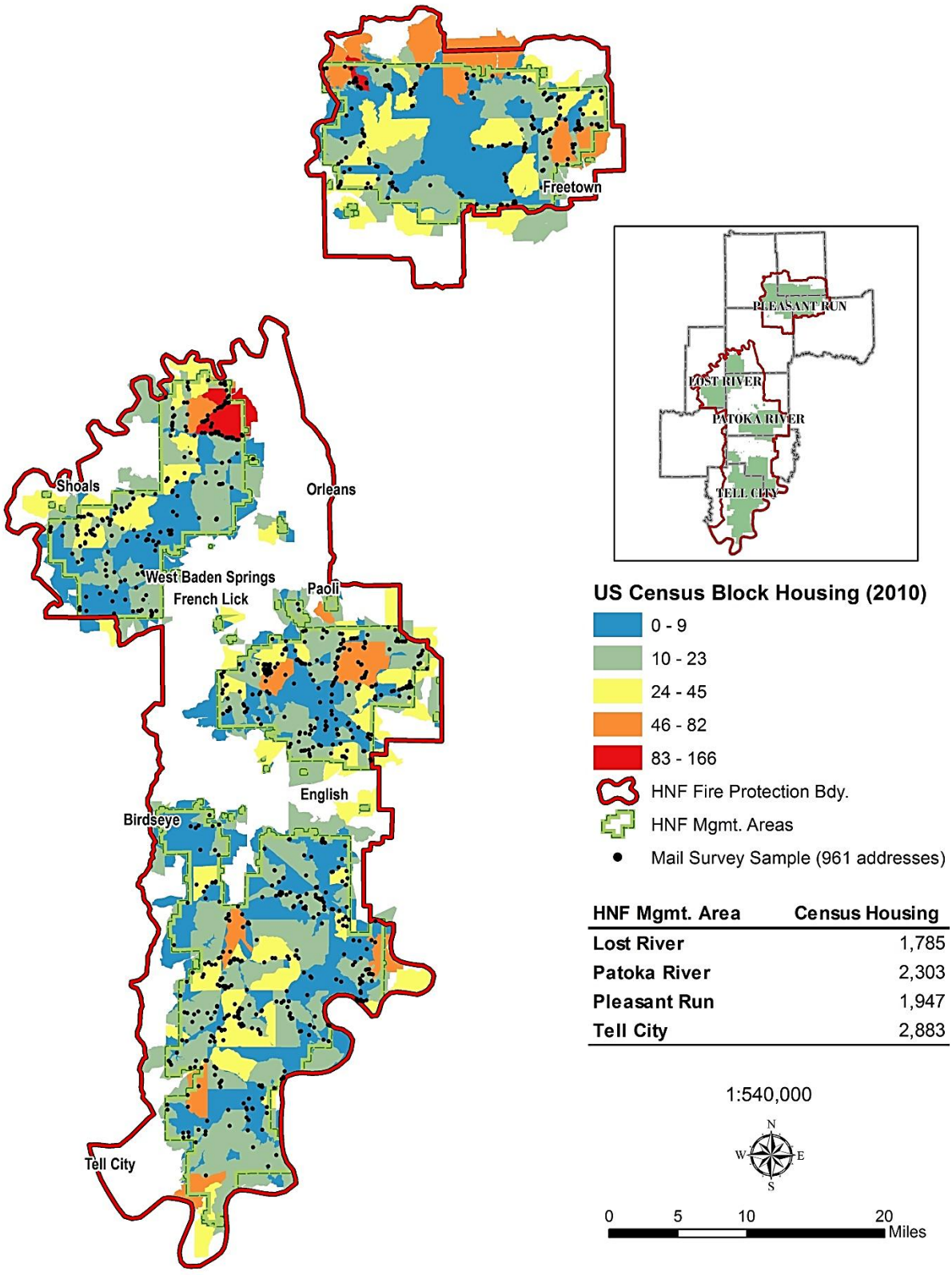
WUI	Acres (zonal)
High Density Interface	1,672
Moderate Density Interface	5,880
Low Density Interface	105,191
High Density Intermix	494
Moderate Density Intermix	2,486
Low Density Intermix	73,453

Map 3-4. HNF WUI Density (Zonal Data).



At Risk Community	Acres (zonal)
At Risk Community	17,904
Not Identified	171,272

Map 3-5. HNF WUI FR-66 At Risk Communities (Zonal Data).



HNF Mgmt. Area	Census Housing
Lost River	1,785
Patoka River	2,303
Pleasant Run	1,947
Tell City	2,883

Map 3-6. Survey Sample (US Census 2010).

Appendix B - ArcGIS Model for WUI Development

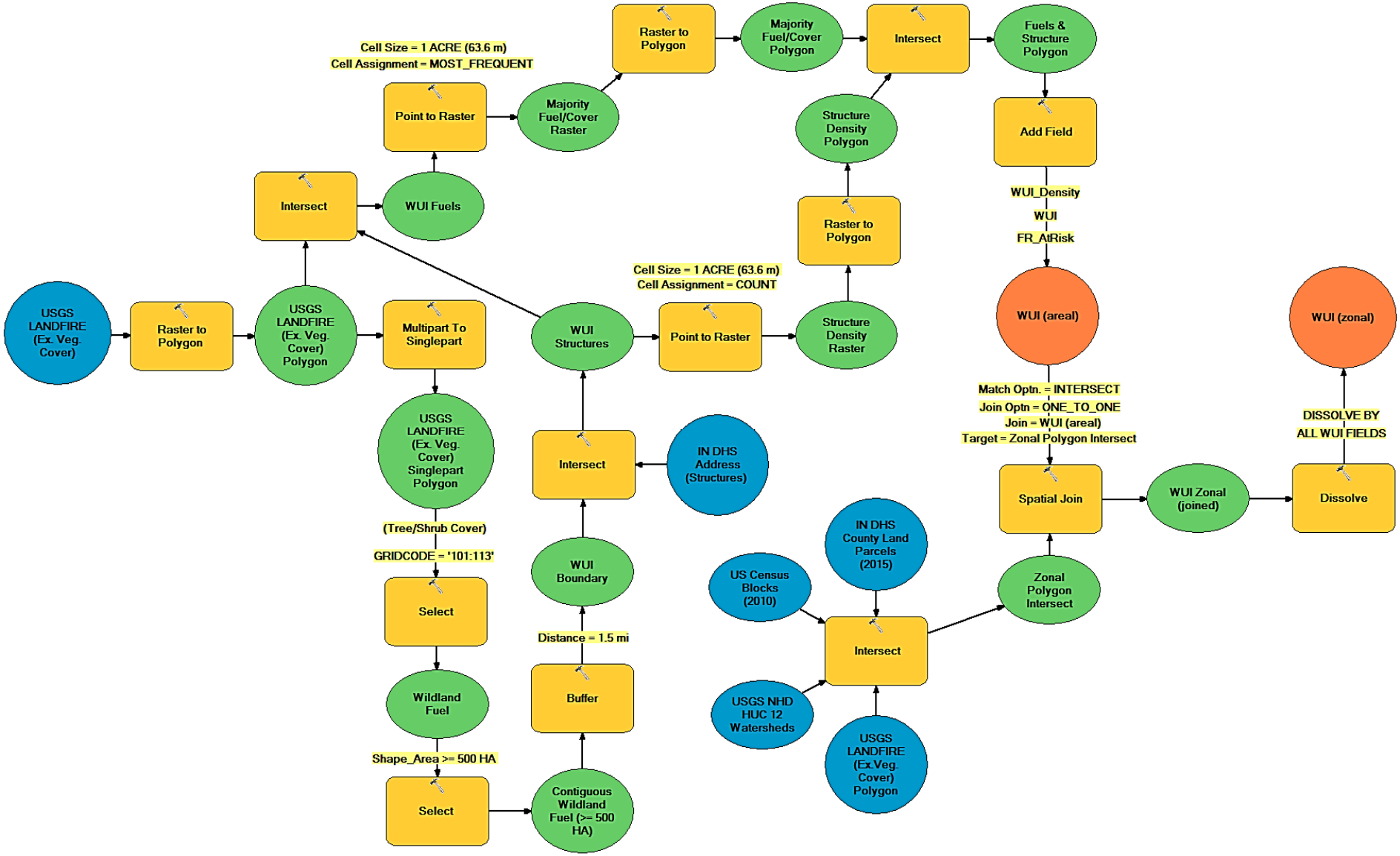


Figure 3-2. ArcGIS 10.2 HNF WUI model tools and inputs.

Appendix C - Survey Questionnaire with Cover Letter

BALL STATE UNIVERSITY

DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL MANAGEMENT

Muncie, Indiana 47306-0495
Phone: 765-285-5780
Fax: 765-285-2606

Thursday, April 02, 2015

Dear Current Resident of Brown County,

I am a graduate student in the Natural Resources and Environmental Management department at Ball State University and I am writing to ask for your help in a research project I am conducting regarding the wildland-urban interface (WUI) in South Central Indiana.

WUI is a community where houses and buildings meet or intermix with wildland fuel (vegetation that has the potential to ignite). Although wildfire is typically perceived as a Western problem in the media, the majority of WUI land is actually in the Eastern United States. Indiana itself has 142 communities that are at high risk from wildfire. Many of these WUI communities are in a nine county area in South- Central Indiana in which the Hoosier National Forest (HNF) is a primary landholder along with the DNR and other state and federal agencies. Because fire has historically played a far greater role on the landscape, public land managers have recently adopted prescribed burning as a management practice to re-introduce fire to landscapes that have been historically adapted to fire. We are trying to better understand if residents like yourself, who live in the WUI, support prescribed fire, or other wildfire management efforts that could happen close to you.

This questionnaire is being sent to randomly selected households with addresses in Brown, Monroe, Martin, Jackson, Lawrence, Orange, Dubois, and Perry Counties that are located in the WUI. Through your participation, researchers will learn more about residents' perceptions and behaviors in the WUI which may improve your local community's capacity to deal with wildfire. In addition the researchers hope that this survey informs you about how you can make your property safer from wildfire, or understand how prescribed fire is used in your community. We will do our best to ensure that overall project findings are reported back to your communities. Please note: **this survey will not impact any codes, regulations, or government policies in your area. It is simply exploratory. Only the researchers (no government entity) will have access to the data.**

This survey should only take 10-15 minutes to complete. Your participation in this research is completely voluntary and you may end your participation at any time. You may also decline to answer specific questions included in the survey. Your answers are **completely confidential** and will only be used in the context of summarizing findings for the entire study in which no individual's answers can be identified. Once you have completed the questionnaire, your address will be deleted from the mailing list and never connected to your answers in any way. Returned questionnaires will be entered into a random drawing for a **$100 Bass Pro Shops© gift card** as a thank you. Because this survey is going out to a small number of people, the chances of winning are very good. The drawing will take place in **March 2015** when we will officially end the survey.

By completing and returning the online survey you are agreeing that you have read this letter and consent to participate in this research. For legal purposes, persons must be 18 years of age or older to participate. The data collected will be stored in a locked filing cabinet until it has been destroyed by the primary investigator two years after the project end date (July 2017). Please keep this letter for your records or future reference. If you have any questions about your rights as a research participant, contact Ball State's Office of Research Integrity at (765) 285-5052 or irb@bsu.edu

Thank you for taking the time to assist us. We realize this is a significant contribution of time on your part and we very much appreciate that. If you require additional information or have questions please don't hesitate to contact me. I'd be happy to speak with you.

Sincerely,

Jason Sprung
Primary Investigator
Dept of Natural Resources and Envir. Mgmt
jmsprung@bsu.edu
765-313-5163

Dr. Joshua Gruver
Assistant Professor
Dept of Natural Resources and Envir. Mgmt
jbgruver@bsu.edu
765-285-5789

ID# [4B]_____

Wildfire and Prescribed Fire in Indiana Communities

A Study Conducted by the Ball State University Department of Natural Resources & Environmental Management with the Cooperation of the Hoosier National Forest

BALL STATE UNIVERSITY

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

To randomize the survey, we ask that this questionnaire be completed by the member of your household over 18 with the most recent birthday (if possible). To help us record your answers correctly, please fill this survey out in pen as opposed to pencil. Please refer to the survey cover letter for more information about why and how we are conducting this survey, as well as your rights as a research participant.

Sharing your views:

- **Please read all the directions and respond by circling the appropriate letter or number or filling in your answer in the space provided**.
- **A common question you'll see throughout this survey is a rating scale**. These questions will ask your level of agreement or level of concern or risk with a statement. For these questions higher numbers reflect positive response. For example: **1= Strongly Disagree; 2=Disagree; 3=Neither Disagree/Agree; 4=Agree; and 5=Strongly Agree**.
- Feel free to write any comments or explanations directly on the questionnaire. The best answers should reflect *your* own experiences, feelings, and beliefs. If you make a correction please initial it.
- Once you have completed, please mail your questionnaire back in the prepaid 9x12 envelope provided.

We will do our best to ensure that overall project findings are reported back to your community. **Thank you very much for your help!**

Your opinions and experience are important to the success of this study!

Wildfire is typically viewed as a Western problem; however most of the wildland urban interface or 'WUI' is located in the Eastern United States. In these areas the close proximity of wildland vegetation and human developments create a hazard. We would like to get your opinions about wildfire in your community and what you do as a land owner to protect your property from wildfire...

1. **Is this address your primary residence? Do you live there all year?**
   a. Yes
   b. No. The season/seasons I live there is/are... _____ (spring, summer, fall, winter?)

Please note: The rest of this survey pertains to the house and property that you occupy in Southern Indiana.

2. **What *WORD* or *PHRASE* would you use to describe wildfire to a friend? (please write it below)**

Wildfire is… _____

3. Wildfire isn't the only environmental threat that occurs in Indiana. *RANK* these natural disasters in order of greatest threat to least threat in your community – with 1 being the most and 7 being the least.

	Rank Order (1 – 7)
a. Wildfire	_____
b. Flooding	_____
c. Severe weather	_____
d. Landslide or sink hole	_____
e. Tornado	_____
f. Drought	_____
g. Earthquake	_____

4. Wildfire isn't the only risk southern Indiana's forests and open spaces currently face. How concerned are you about each of the following forest risks for your community?

	No Concern - - - - - - - - - - - - - - - Very Concerned				
a. Wildfire	1	2	3	4	5
b. Harmful pests (Emerald Ash Borer, Dutch Elm, etc.)	1	2	3	4	5
c. Decline in wildlife habitat	1	2	3	4	5
d. Loss of forests to development	1	2	3	4	5
e. Loss of farmland to development	1	2	3	4	5
f. Invasive species (Bush Honeysuckle, Garlic Mustard, etc.)	1	2	3	4	5
g. Decline in forest resources and employment	1	2	3	4	5
h. Loss of open space and scenic beauty	1	2	3	4	5
i. Erosion and soil loss	1	2	3	4	5
j. Quality access to public lands for outdoor recreation	1	2	3	4	5
k. Climate change	1	2	3	4	5

5. How does fire fit into Indiana's landscape? Please indicate whether you agree or disagree with each of the following statements…

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. Fire is beneficial to some of Indiana's native plants, trees, and wildlife.	1	2	3	4	5
b. Fire is not necessary to maintain a natural balance in Indiana.	1	2	3	4	5
c. Fire is dangerous to property, people, and woodlands and should be suppressed.	1	2	3	4	5
d. Fire should be managed for resource benefits and only suppressed as a last resort.	1	2	3	4	5
e. Fire in the past had a much greater impact on Indiana's forests.	1	2	3	4	5

6. For each of the following areas, how great a risk do you feel wildfires pose?

		No Risk - High Risk				
a.	Do you feel your home is at risk from wildfire?	1	2	3	4	5
b.	The land adjacent to your home?	1	2	3	4	5
c.	Your neighbor's property?	1	2	3	4	5
d.	Your community?	1	2	3	4	5
e.	The wider region?	1	2	3	4	5

7. Before taking this survey, had you ever heard of the following terms or organizations?

		Yes	No
a.	"Wildland Urban Interface" or "WUI"	Y	N
b.	"Defensible Space"	Y	N
c.	"Firewise"	Y	N
d.	"Fire Adapted Communities" or "Fire Adapted"	Y	N
e.	"Prescribed Fire" or "Controlled Burning"	Y	N

8. Do you know anyone who has experienced a wildfire, had a home or property damaged by smoke or wildfire, or evacuated due to the threat of a wildfire?

a. Yes b. No

9. Have you *PERSONALLY* experienced a wildfire on or near your property in the past?

a. Yes

b. No → ***If you have never experienced a wildfire skip to question #14.***

10. Was your home or property damaged by the smoke from a wildfire?

a. Yes b. No

11. Was your home or property damaged by the wildfire itself (fire or heat damage)?

a. Yes b. No

12. Who responded to this wildfire? (select all that apply)

a. Local Fire Department

b. State or Federal Agency Fire (DNR or Forest Service)

c. Landowner response

d. No response

e. Don't know

13. Based upon your personal experiences, how strongly do you agree with each of the following statements:

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. The firefighters that responded to the wildfire had a high level of readiness/preparedness.	1	2	3	4	5
b. The firefighters that responded to the wildfire had enough equipment and personnel to suppress the fire effectively.	1	2	3	4	5
c. If there was a much larger wildfire, I would place a great amount of trust to these firefighters ability to respond to the fire in an effective manner.	1	2	3	4	5

14. In your opinion, how much do each of the following contribute to wildfire risk in your community?

	None - - - - - - - - - - - - - - - - - - - Significant				
a. Build-up of vegetation on public land	1	2	3	4	5
b. Build-up of vegetation on private land	1	2	3	4	5
c. Increased number of houses being built	1	2	3	4	5
d. Timber cutting practices	1	2	3	4	5
e. Arson	1	2	3	4	5
f. Careless burning (brush, leaves, or trash)	1	2	3	4	5
g. Recreational use on public land	1	2	3	4	5
h. Harmful pests (Emerald Ash Borer, etc.)	1	2	3	4	5
i. Natural processes (drought, lightning, etc.)	1	2	3	4	5
j. Public land management	1	2	3	4	5
k. Prescribed/controlled burning	1	2	3	4	5
l. Local management	1	2	3	4	5
m. Climate change	1	2	3	4	5

15. Here is a list of activities commonly conducted by homeowners to reduce their risk to wildfire. Please indicate if you've done these as well as how likely it is you will do them in the future...

	Yes	No	➡ Very Unlikely - - - - - - - - - - - - - - - Very Likely				
a. Speak to a neighbor about wildfire risk.	Y	N	1	2	3	4	5
b. Clear vegetation and litter around your home and property to reduce wildfire risk.	Y	N	1	2	3	4	5
c. Use fire resistant building materials on your home or outbuildings.	Y	N	1	2	3	4	5
d. Participate in efforts to reduce hazardous fuels around your community.	Y	N	1	2	3	4	5
e. Contact the Forest Service or DNR for information about wildfire and prescribed fire in your community.	Y	N	1	2	3	4	5

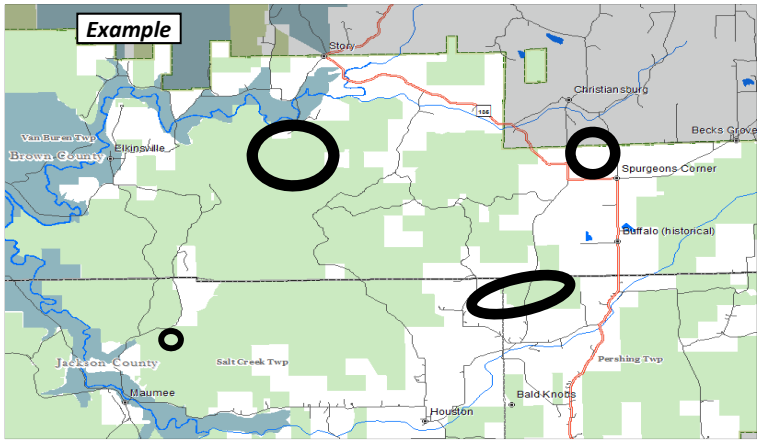
16. Have any of your neighbors done any of the above activities to reduce the risk of wildfire on their property?

a. Yes b. No

17. How much of a role should southern Indiana's private citizens play in reducing wildfire hazards on their property? How much do you agree with the statements below...

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. Reducing wildfire hazards is not the homeowner's problem.	1	2	3	4	5
b. Reducing wildfire hazards is best left to private organizations, companies, and communities.	1	2	3	4	5
c. Residents should prepare for a wildfire, but there should be cost sharing and incentives from institutional organizations (insurance, government agencies, etc.) to offset the burden on private citizens.	1	2	3	4	5
d. Reducing wildfire hazards is entirely the homeowners responsibility.	1	2	3	4	5

18. Please see the attached color map at the end of this questionnaire for this question.



A map of your area is included at the end of the questionnaire. Based on your personal experiences and opinion of wildfire, please indicate on the map which areas you think represent the greatest fire risk (or you feel would be problematic if a wildfire ever occurred). **You can circle up to 4 areas of the map.**

Prescribed fire is frequently used on the public/private land that makes up the greater Hoosier National Forest area. Some areas are burned to improve Oak/Hickory growth, while others are burned to increase native grasses and keep the areas open for wildlife. We would like to get some idea of your opinions about prescribed fire and its use in your community...

19. What *WORD* or *PHRASE* would you use to describe prescribed or controlled fire to a friend? (please write it below)

Prescribed / controlled fire is… _____

20. Have you ever seen or been informed of a prescribed fire being conducted on or near your property?

a. Yes b. No

21. In the past year have you seen or heard anything about prescribed fire in your community?

a. A great deal

b. A moderate amount

c. A little

d. I haven't heard anything → ***If you haven't heard anything skip to question #24.***

22. How did you get this information? (please select all that apply)

a. Television

b. Internet

c. Direct mail

d. Newspaper

e. My own observations

f. Radio

g. Public meeting

h. Government entity (USFS, DNR, etc.)

i. Flyers or bulletins

j. Word-of-mouth

k. Other (please specify) _____

23. Based on your answers above, which *SINGLE* source do you trust…

a. The MOST likely to provide accurate and reliable information? _____

b. The LEAST likely to provide accurate and reliable information? _____

24. Prescribed fire is conducted by land managers to achieve specific resource objectives. What are your views on how natural resources in Southern Indiana should be used?

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. The needs of people in the present are more pressing than future generations.	1	2	3	4	5
b. It is important to set aside more land for wilderness to protect it from possible development.	1	2	3	4	5
c. Land managers should provide natural resources to support local industries which depend on them.	1	2	3	4	5
d. Indiana's public lands should be managed for multiple uses such as timber harvesting, outdoor recreation, and wildlife.	1	2	3	4	5
e. We should protect ecosystems, endangered species, and wildlife habitat, even if that means hurting some industries.	1	2	3	4	5
f. The government should not be involved in the management of public lands. The private sector would be more effective.	1	2	3	4	5
g. Land managers should work to expand access (build more trails and roads) on public lands.	1	2	3	4	5
h. Economic growth is more important than the environment.	1	2	3	4	5
i. People have a right to modify the natural environment to meet their needs.	1	2	3	4	5
j. Local economic concerns play too great a role in multiple use management decisions on Indiana's public lands.	1	2	3	4	5
k. Local residents should have more of a role in decisions impacting Indiana's public lands.	1	2	3	4	5

25. How much do you agree with the following statements about prescribed fire in your community...

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. Prescribed fire is just as dangerous to public safety as wildfire.	1	2	3	4	5
b. Smoke from prescribed fire poses as much of a threat to public health and air quality as that of a wildfire.	1	2	3	4	5
c. I'm concerned that a prescribed fire could escape control and become a wildfire.	1	2	3	4	5
d. Prescribed burning destroys what once was a beautiful landscape.	1	2	3	4	5
e. Prescribed fire improves wildlife habitat, creating better opportunities for hunting.	1	2	3	4	5
f. Prescribed fire is necessary for a healthy forest ecosystem.	1	2	3	4	5

26. How strongly do you agree with each of the following statements about using prescribed fire in your community?

	Strongly Disagree - - - - - - - - - - - - - - - Strongly Agree				
a. I trust the government to make proper decisions about the use of prescribed burning.	1	2	3	4	5
b. The government should use prescribed burning as a tool whenever they see fit.	1	2	3	4	5
c. Prescribed burning should be used infrequently, in carefully selected areas, and only with public approval.	1	2	3	4	5
d. Prescribed burning is a valuable land management practice and should be widely adopted.	1	2	3	4	5
e. Prescribed burning is a reckless management practice in this area because of too many negative impacts.	1	2	3	4	5
f. My views have changed over time to be more accepting of prescribed fire in my community.	1	2	3	4	5

When it comes to natural resource issues like wildfire, locality does matter. We would like get some basic knowledge about where you live, how much land you own, and how active you are in your community...

27. What is the closest town or city to where you live? (if the town is in Kentucky, please note by adding KY)

_____

28. How many years have you lived at this current property?

_____ (number of years)

29. How many years have you been in this community (regardless of current address)?

_____ (number of years)

30. What best describes your residence on this property?

a. Multi-family housing (apartment, condo, duplex)

b. Single-family house

c. Mobile home/trailer

d. Other (please explain) _____

31. Do you own this home/property outright? Do you have homeowners insurance or something similar like renters insurance?

		Yes	No
a.	I own this home/property outright	Y	N
b.	I have homeowners insurance or something similar	Y	N

32. What best describes the character of your current residential area?

a. Farm or other large land holding

b. Exurban (large rural lot situated beyond the suburbs)

c. Old town/settlement (a small village or cluster of houses)

d. Suburban (small lots situated beyond a town or city)

e. Urban (small lot or dwelling within city limits)

33. What is the distance from your house to the nearest house or outbuilding (like a shed or barn) that lies outside your property line?

a. Less than 25 feet

b. 25 – 100 feet

c. More than 100 feet

34. Why did you decide to live in Southern Indiana? (you can select multiple answers)

a. Change in marital status

b. New job

c. Closer to work or school/easier commute

d. Good schools

e. Good neighborhood

f. Close to outdoor amenities and recreation

g. Affordable land

h. Affordable housing

i. Better cost of living

j. Ties to family, local community, and the land

k. Wanted a new/better home or apartment

l. To live in a place where people share my values

m. Beautiful scenery

n. Real estate investment

o. Privacy

p. An escape from busy urban life

q. Less government regulation and/or taxes

r. To be part of an exclusive community

s. Retirement

t. A second/vacation home

u. Other (please explain) _____

35. We want to know what you think about where you live. Please select what best describes your community for each of the following components…

	Very Poor - Very Good				
a. Quality of Life	1	2	3	4	5
b. Local economy	1	2	3	4	5
c. Places to visit or recreate	1	2	3	4	5
d. Availability of affordable housing	1	2	3	4	5
e. Local government	1	2	3	4	5
f. Level of communication among residents	1	2	3	4	5
g. Providing necessary services	1	2	3	4	5
h. Safety and crime	1	2	3	4	5
i. Cost of living	1	2	3	4	5
j. Community's change over time	1	2	3	4	5

36. Have you participated in any of the following activities during the past year? How often do you do these?

	Yes	No ➡	Never - Very Often				
a. Attended a local community event or festival	Y	N	1	2	3	4	5
b. Attended a public meeting addressing a community issue	Y	N	1	2	3	4	5
c. Served as an officer in a community organization (i.e. homeowners assoc.)	Y	N	1	2	3	4	5
d. Contacted a local official about some local issue of concern	Y	N	1	2	3	4	5
e. Served on a local government committee or board	Y	N	1	2	3	4	5
f. Voted in an election	Y	N	1	2	3	4	5

37. Do you or any of your family visit the Hoosier National Forest, DNR State Forests, Parks, or Fish and Wildlife Areas for recreation or employment?

a. Yes

b. No ➡ ***If you never visit public land skip to question #39.***

38. How often do you visit these places?

a. Once a year

b. Several times a year

c. Several times a month

d. Several times a week

e. Daily

39. How often do you interact with natural resource professionals at these places or in the community (Forest Service, DNR, USDA, NRCS, etc.)?

a. Never b. Rarely c. Sometimes d. Often

40. Do you own land in your community?

a. Yes

b. No → ***If you do not have any land skip to question #49.***

41. How many total acres do you own in your community? Enter the size of acreage you have as property below.

_____ (number of acres)

42. If you own land does a portion of your income come from your property? (farming, logging, fees for recreation, income from government programs, etc.)

a. Yes b. No

43. Have you talked with anyone or received advice/information about care, management, or protection of your land in the past 5 to 10 years?

a. Yes b. No

44. Is any of your land actively enrolled in a conservation status (e.g. CRP or Classified Forest)?

a. Yes b. No

45. How likely is it that you will sell or give away any land in the next 5 to 10 years?

a. Very Unlikely
b. Unlikely
c. Undecided
d. Likely
e. Very Likely

46. Do you actively manage your land? (do you farm, landscape, harvest timber, manage for wildlife, etc.)

a. Yes

b. No → ***If you do not manage your land skip to question #49.***

47. What kinds of management activities do you do on your land? (select all that apply)

a. Timber production/harvest
b. Stream bank improvements
c. Soil conservation/erosion control
d. Grazing/pasture
e. Conventional farming
f. Landscaping/gardening
g. Organic farming
h. Pond for fish/waterfowl
i. Wildlife habitat improvement
j. Sustenance farming or haying
k. Outdoor recreation (ATV trails etc.)
l. Other (please explain) _____

48. When making management decisions on your land, how important are each of the following factors?

		Least Important - - - - - - - - - - - Most Important				
a.	Economic Factors (costs, prices, markets, incentives)	1	2	3	4	5
b.	Social Factors (regulation, community, family/friends)	1	2	3	4	5
c.	Physical Factors (land quality, resources, productivity)	1	2	3	4	5
d.	Operational Factors (labor, capital, equipment)	1	2	3	4	5
e.	Personal Interests (time, values, risk)	1	2	3	4	5

Finally, we would like to ask a few questions about you and your family. Your answers will help us learn about the residents who live, work, and play around the Hoosier National Forest in Indiana...

49. What year were you born?

_____

50. What is your gender?

a. Male b. Female

51. What best describes your race or ethnicity?

a. White
b. African American
c. Native American
d. Asian
e. Latino/Hispanic
f. Other (please elaborate) _____

52. What is your marital status? Do you have a family?

a. Single; no children
b. Single; with children at home
c. Single; no children at home
d. Married; no children
e. Married; with children at home
f. Married; no children at home

53. How many people live in your household?

a. Number of people under 18? _____
b. Number of people over 18? _____

54. In general how would you describe your views and beliefs?

a. Consistently Conservative
b. Mostly Conservative
c. Mixed / Moderate
d. Mostly Liberal
e. Consistently Liberal

55. What was the highest grade of school you completed?

a. No diploma
b. High school graduate (includes GED)
c. Some college (no degree or some post high school training)
d. Associates degree (two year technical)
e. Bachelor's degree (BA/BS)
f. Graduate or professional degree (MA/MS, JD, MD, PhD)

56. What best describes the current field that your occupation is in?

a. Agriculture (forestry, farming, etc.)
b. Mining/Oil and Gas
c. Construction
d. Manufacturing
e. Wholesale or Retail
f. Small business/Entrepreneur
g. Education
h. Arts/Entertainment
i. Hospitality (accommodation, tourism, etc.)
j. Public administration
k. Legal Profession
l. Law Enforcement
m. Transportation
n. Energy and Utilities
o. Information and Technology
p. Finance and Insurance
q. Health Care
r. Specialty Management
s. Design and Engineering
t. Military
u. Student
v. Unemployed
w. Retired
x. Other (please elaborate) _____

57. What is your average yearly household income?

a. Less than $15,000
b. $15,000 to $24,999
c. $25,000 to $34,999
d. $35,000 to $49,999
e. $50,000 to $74,999
f. $75,000 to $99,999
g. $100,000 to $149,999
h. $150,000 or more

This ends the questionnaire. By mailing this completed survey back in the prepaid envelope you will be entered into a drawing for a $100 Bass Pro Shops gift card! Thank you so much for participating in this survey from the Ball State Department of Natural Resources & Environmental Management. Your opinion and experience matters!

Appendix D - Survey Post Card

Ball State University Department of Natural Resources & Environmental Mgmt.

Wildfire & Prescribed Fire Survey

Thank You So Much For Your Participation!

You recently received a questionnaire from the Ball State University Department of Natural Resources & Environmental Mgmt. If you have completed and returned the survey we thank you very much! Your address will be entered into our random drawing for a Bass Pro Shops© gift card valued at $100!

The Survey Isn't Over Yet. There's Still Time Left to Return the Questionnaire and Win if You Haven't Already!

Ball State University
Dept. NREM
Muncie, IN
47306-0495

Jason Sprung
Primary Investigator
(765) 313 - 5163
jmsprung@bsu.edu

BALL STATE UNIVERSITY

YOUR OPINIONS AND EXPERIENCE ARE IMPORTANT TO THE SUCCESS OF THIS SURVEY!

Study outcomes will be used to help wildfire and natural resource professionals in southern Indiana understand the social and physical complexities influencing resident's perceptions of wildfire and prescribed fire.

IF YOU NEED ANOTHER SURVEY, PLEASE CONTACT THE PRIMARY INVESTIGATOR LISTED ABOVE.

If you have any questions about your rights as a research participant, contact Ball State's Office of Research Integrity at: **(765) 285-5052 – or –** irb@bsu.edu

Appendix E - Survey Frequency & Descriptive Table

Q1. Is this address your primary residence? Do you live there all year?

	Percent %	N
No. Seasons I live there are:	1.5	2
Yes	98.5	131
N	133	
Min	0	
Max	1	
Mean	0.98	
SD	0.122	

Seasonal Residence:
all
weekends; spring, summer, fall, winter

Q2. What WORD or PHRASE would you use to describe wildfire to a friend?

	Phrase	(%)	N
#1	out of control	16.1	23
#2	dangerous	12.6	18
#3	scary	8.4	12
#4	devastating	7.0	10
N	143		

Q3. RANK these natural disasters in order of greatest threat to least threat in your community

	#1 (%)	#2 (%)	#3 (%)	#4 (%)	#5 (%)	#6 (%)	#7 (%)	N	Min	Max	Mean	SD
Wildfire	8.8	4.4	17.5	24.8	25.5	10.2	8.8	137	1	7	4.2	1.603
Flooding	16.8	21.9	14.6	16.8	9.5	7.3	13.1	137	1	7	3.55	1.981
Severe weather	40.1	21.2	17.5	10.2	5.1	4.4	1.5	137	1	7	2.38	1.544
Landslide or sink hole	2.9	4.4	4.4	8.8	16.1	34.3	29.2	137	1	7	5.5	1.549
Tornado	27.7	27.7	20.4	8.8	5.8	5.8	3.6	137	1	7	2.69	1.656
Drought	3.6	8.8	21.2	24.1	21.2	15.3	5.8	137	1	7	4.2	1.489
Earthquake	2.2	3.6	5.1	5.1	15.3	23.4	45.3	137	1	7	5.79	1.541

Q4. How concerned are you about each of the following forest risks for your community?

				None ⟷ Very								
	Low	**Mod**	**High**	**0 (%)**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
Wildfire	19.6	46.4	34.1	5.8	13.8	46.4	19.6	14.5	138	0	4	2.23	1.048
Harmful pests	10.3	22.1	67.7	0.7	9.6	22.1	33.1	34.6	136	0	4	2.91	1.007
Decline in wildlife habitat	17.8	22.2	60.0	5.2	12.6	22.2	31.1	28.9	135	0	4	2.66	1.173
Loss of forests to development	14.7	23.5	61.8	3.7	11.0	23.5	25.0	36.8	136	0	4	2.8	1.16
Loss of farmland to development	17.6	19.9	62.5	5.1	12.5	19.9	27.2	35.3	136	0	4	2.75	1.21
Invasive species	25.0	40.4	34.6	7.4	17.6	40.4	24.3	10.3	136	0	4	2.13	1.057
Decline in forest resources and jobs	18.4	40.4	41.1	5.9	12.5	40.4	27.9	13.2	136	0	4	2.3	1.042
Loss of open space and scenic beauty	18.8	22.5	58.7	6.5	12.3	22.5	34.8	23.9	138	0	4	2.57	1.171
Erosion and soil loss	20.2	27.6	52.3	3.0	17.2	27.6	35.1	17.2	134	0	4	2.46	1.06
Quality access to public lands	23.6	26.5	50.0	9.6	14.0	26.5	30.9	19.1	136	0	4	2.36	1.215
Climate change	35.0	29.2	35.8	20.4	14.6	29.2	16.8	19.0	137	0	4	1.99	1.38

Q5. How does fire fit into Indiana's landscape?

				SD ⟷ SA								
	Neg.	**Neu.**	**Pos.**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**5 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
Fire is beneficial to some of Indiana's native plants, trees, and wildlife	11.7	28.5	59.9	6.6	5.1	28.5	28.5	31.4	137	1	5	3.73	1.154
Fire is not necessary to maintain a natural balance in Indiana	48.9	32.1	19.0	22.6	26.3	32.1	11.7	7.3	137	1	5	2.55	1.176

Fire is dangerous and should be suppressed	22.1	40.4	37.5	9.6	12.5	40.4	14.7	22.8	136	1	5	3.3	1.2
Fire should be managed for resource benefits	21.9	27.7	50.4	11.7	10.2	27.7	29.2	21.2	137	1	5	3.4	1.3
Fire in the past had a much greater impact on Indiana's forests	17.3	46.6	36.0	5.3	12.0	46.6	18.0	18.0	133	1	5	3.32	1.069

Q6. For each of the following areas, how great a risk do you feel wildfires pose? (risk)

				None ⟷				High					
	Low	**Mod**	**High**	**0 (%)**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
Is your home at risk from wildfire?	40.6	25.9	33.6	15.4	25.2	25.9	20.3	13.3	143	0	4	1.91	1.267
The land adjacent to your home?	22.6	25.4	52.1	9.2	13.4	25.4	28.9	23.2	142	0	4	2.44	1.24
Your neighbor's property?	26.1	28.9	45.1	9.2	16.9	28.9	25.4	19.7	142	0	4	2.3	1.225
Your community?	27.6	36.2	36.1	9.9	17.7	36.2	25.5	10.6	141	0	4	2.09	1.121
The wider region?	19.1	34.5	46.5	8.5	10.6	34.5	34.5	12.0	142	0	4	2.31	1.086

Q7. Before taking this survey, had you ever heard of the following terms or organizations?

	Y (%)	**N (%)**	**N**	**Mean**	**SD**
"Wildland Urban Interface" or "WUI"	10.5	89.5	143	0.1	0.307
"Defensible Space"	18.3	81.7	142	0.18	0.388
"Firewise"	31.7	68.3	142	0.32	0.467
"Fire Adapted Communities"	12.6	87.4	143	0.13	0.333
"Prescribed Fire" or "Controlled Burning"	93.7	6.3	143	0.94	0.244

Q8. Do you know anyone who has experienced a wildfire…etc.?

	(%)	N
Yes	29.6	42
No	70.4	100
N	142	
Min	0	
Max	1	
Mean	0.3	
SD	0.458	

Q9. Have you PERSONALLY experienced a wildfire on or near your property in the past?

	(%)	N
Yes	23.2	33
No	76.8	109
N	142	
Min	0	
Max	1	
Mean	0.23	
SD	0.424	

Q10. Was your home or property damaged by the smoke from a wildfire?

	(%)	N
Yes	12.1	4
No	87.9	29
N	33	
Min	0	
Max	1	
Mean	0.12	
SD	0.331	

Q11. Was your home or property damaged by the wildfire itself (fire or heat damage)?

	(%)	N
Yes	15.2	5
No	84.8	28
N	33	
Min	0	
Max	1	
Mean	0.15	
SD	0.364	

Q12. Who responded to this wildfire?

	(%)	N
Local Fire Department	41.1	23
State or Federal Agency Fire	16.1	9
Landowner response	37.5	21
No response	1.8	1
Don't Know	3.6	2
N	56	

Q13. Based upon your personal experiences, how strongly do you agree with each of the following statements:

				SD ⟷ SA									
	Neg.	Neu.	Pos.	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	N	Min	Max	Mean	SD
The firefighters that responded had a high level of readiness/preparedness	13	12.9	74.2	6.5	6.5	12.9	41.9	32.3	31	1	5	3.87	1.147
The firefighters that responded to the wildfire had enough eqpt. and personnel	22.6	16.1	61.3	16.1	6.5	16.1	35.5	25.8	31	1	5	3.48	1.387
If there was a much larger wildfire, I would place a great amount of trust to these firefighters	32.2	12.9	54.9	16.1	16.1	12.9	32.3	22.6	31	1	5	3.29	1.419

Q14. In your opinion, how much do each of the following contribute to wildfire risk in your community?

				None ⟷ Sig.									
	Low	Mod.	High	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	N	Min	Max	Mean	SD
Build-up of vegetation on public land	22.3	30.2	47.5	6.5	15.8	30.2	25.9	21.6	139	0	4	2.4	1.178
Build-up of vegetation on private land	28.2	33.3	38.4	6.5	21.7	33.3	26.8	11.6	138	0	4	2.15	1.093
Increased number of houses being built	47.1	31.6	21.3	19.9	27.2	31.6	19.1	2.2	136	0	4	1.57	1.08
Timber cutting practices	42.0	33.3	24.7	15.9	26.1	33.3	16.7	8	138	0	4	1.75	1.153
Arson	36.2	20.3	43.5	15.9	20.3	20.3	22.5	21	138	0	4	2.12	1.38
Careless burning	9.4	12.2	78.4	2.2	7.2	12.2	32.4	46	139	0	4	3.13	1.027
Recreational use on public land	30.2	35.3	34.5	10.1	20.1	35.3	26.6	7.9	139	0	4	2.02	1.093
Harmful pests	35.7	33.6	30.7	13.6	22.1	33.6	15.7	15	140	0	4	1.96	1.237

Natural processes	12.3	33.1	54.7	2.2	10.1	33.1	37.4	17.3	139	0	4	2.58	0.963	
Public land management	48.2	32.6	19.3	15.6	32.6	32.6	11.9	7.4	135	0	4	1.63	1.111	
Prescribed/controlled burning	52.2	26.8	21.0	18.1	34.1	26.8	11.6	9.4	138	0	4	1.6	1.187	
Local management	62.2	27.4	10.4	21.5	40.7	27.4	7.4	3	135	0	4	1.3	0.986	
Climate change	56.9	28.8	14.4	28.1	28.8	28.8	11.5	2.9	139	0	4	1.32	1.092	

Q15. Please indicate if you've done these as well as how likely it is you will do them in the future...

								VU ← 1 (%)	2 (%)	3 (%)	4 (%)	→ VL 5 (%)			
	Y (%)	**N (%)**	**N**	**SD**	**Low**	**Mod.**	**High**						**N**	**Mean**	**SD**
Speak to a neighbor about wildfire risk	25.5	74.5	137	0.438	62.6	21.1	16.2	39.8	22.8	21.1	8.9	7.3	123	2.21	1.263
Clear vegetation and litter around you home and property	81.9	18.1	138	0.387	25.2	15.4	59.3	16.3	8.9	15.4	26.8	32.5	123	3.5	1.439
Use fire resistant building materials on your home or outbuildings	45.3	54.7	137	0.5	36.1	30.3	33.6	19.7	16.4	30.3	15.6	18	122	2.96	1.357
Participate in efforts to reduce hazardous fuels in your community	30.7	69.3	137	0.463	56.1	24.4	19.6	30.1	26	24.4	9.8	9.8	123	2.43	1.281
Contact the Forest Service or DNR for information about wildfire and prescribed fire in your community	20.7	79.3	135	0.407	56.1	25.2	18.7	33.3	22.8	25.2	9.8	8.9	123	2.38	1.284

Q16. Have any of your neighbors done any of the above activities?

	Percent (%)	**N**
Yes	44.6	58
No	55.4	72
N	130	

Min	0
Max	1
Mean	0.45
SD	0.499

Q17. How much of a role should southern Indiana's private citizens play in reducing wildfire hazards on their property?

				SD ←				→ SA				
	Neg.	**Neu.**	**Pos.**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**5 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
Reducing wildfire hazards is not the homeowner's problem	78.1	14.2	7.8	58.2	19.9	14.2	3.5	4.3	141	1	5	1.76	1.095
Reducing wildfire hazards is best left to private organizations, companies, and communities	72.2	16.4	11.4	42.9	29.3	16.4	6.4	5	140	1	5	2.01	1.144
Residents should prepare for a wildfire, but there should be cost sharing and incentives from orgs.	27.2	25.7	47.1	13.6	13.6	25.7	30	17.1	140	1	5	3.24	1.273
Reducing wildfire hazards is entirely the homeowners responsibility	64.0	20.9	15.2	45.3	18.7	20.9	5.8	9.4	139	1	5	2.15	1.313

Q18. Please see the attached color map at the end of this questionnaire for this question.

	(%)	N
Response	74.6	106
No Response	25.4	36
N	142	
Min	0	

Q19 What WORD or PHRASE would you use to describe prescribed or controlled fire to a friend?

	Phrase	(%)	N
#1	necessary	10.5	15
#2	beneficial	9.8	14
#3	helpful	2.1	3
#4	ugly	1.4	2

Max	1
Mean	0.75
SD	0.437

Q20. Have you ever seen or been informed of a prescribed fire being conducted near your property?

	Percent (%)	N
Yes	44.0	62
No	56	79
N	141	
Min	0	
Max	1	
Mean	0.44	
SD	0.498	

Q21. In the past year have you seen or heard anything about prescribed fire in your community?

	(%)	N
A great deal	8.5	12
A moderate amount	14.8	21
A little	27.5	39
I haven't heard anything	49.3	70
N	142	
Min	0	
Max	3	
Mean	0.82	
SD	0.977	

Q22. How did you get this information?

	(%)	N
Television	2.5	4
Internet	1.9	3
Direct mail	7.4	12
Newspaper	23.5	38
My own observations	18.5	30
Radio	4.9	8
Public meeting	1.2	2
N	143	

*Other:
- posted signs
- the smell of smoke
- I'm a volunteer firefighter
- see smoke - too late!
- come around to let know

Q23. Based on your answers above, which SINGLE source do you trust…

The MOST likely to provide accurate and reliable information?

	Info Source	(%)	N
#1	newspaper	14.0	20
#2	gov. entity	12.6	18
#3	direct mail	7.7	11
#4	my own obs.	5.6	8
N	143		

Gov.entity (USFS, DNR, etc.)	11.7	19
Flyers or bulletins	1.9	3
Word-of-mouth	22.8	37
Other	3.7	6
N	162	

The LEAST likely to provide accurate and reliable information?

	Info Source	(%)	N
#1	word-of-mouth	24.5	35
#2	government entity	4.2	6
#3	internet	3.5	5
#4	TV & my own obs.	2.8	4
N	143		

Q24. What are your views on how natural resources in Southern Indiana should be used?

				SD ←				→ SA				
	Neg.	Neu.	Pos.	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	N	Min	Max	Mean	SD
The needs of people in the present are more pressing than future generations	69.3	22.6	8.0	39.4	29.9	22.6	2.9	5.1	137	1	5	2.04	1.097
It is important to set aside land for wilderness to protect it from possible development	21.0	20.3	58.7	13	8	20.3	26.1	32.6	138	1	5	3.57	1.361
Land managers should provide natural resources to support local industries which depend on them	22.0	46.3	31.6	5.1	16.9	46.3	23.5	8.1	136	1	5	3.13	0.962
Indiana's public land should be managed for multiple uses such as timber harvesting, outdoor recreation, and wildlife	12.3	13.8	73.9	4.3	8	13.8	34.8	39.1	138	1	5	3.96	1.117
We should protect ecosystems, endangered species, and wildlife habitat, even if that means hurting some industries	14.1	28.9	57.0	1.5	12.6	28.9	23.7	33.3	135	1	5	3.75	1.098
The government should not be involved in the management of public lands. The private sector would be more effective	45.6	32.4	22.1	21.3	24.3	32.4	10.3	11.8	136	1	5	2.67	1.253
Land managers should work to expand	31.7	32.4	36.1	11.8	19.9	32.4	19.9	16.2	136	1	5	3.09	1.232

access on public lands													
Economic growth is more important than the environment	73.2	21.7	5.0	39.1	34.1	21.7	3.6	1.4	138	1	5	1.94	0.942
People have a right to modify the natural environment to meet their needs	51.4	27.5	21.0	23.9	27.5	27.5	10.9	10.1	138	1	5	2.56	1.25
Local economic concerns play too great a role in multiple use management decisions on Indiana's public lands	25.2	48.9	25.9	6.7	18.5	48.9	18.5	7.4	135	1	5	3.01	0.97
Local residents should have more of a role in decisions impacting Indiana's public lands	4.4	19.6	76.1	2.2	2.2	19.6	40.6	35.5	138	1	5	4.05	0.915

Q25. How much do you agree with the following statements about prescribed fire in your community…

				SD ←				→ SA					
	Neg.	**Neu.**	**Pos.**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**5%**	**N**	**Min**	**Max**	**Mean**	**SD**
Prescribed fire is just as dangerous to public safety as wildfire	65.4	16.5	18.0	30.9	34.5	16.5	10.1	7.9	139	1	5	2.29	1.23
Smoke from prescribed fire poses as much of a threat to public health and air quality as that of a wildfire	43.2	24.5	32.4	14.4	28.8	24.5	20.9	11.5	139	1	5	2.86	1.235
I'm concerned that a prescribed fire could escape control and become a wildfire	37.7	26.1	36.2	9.4	28.3	26.1	23.9	12.3	138	1	5	3.01	1.184
Prescribed burning destroys what once was a beautiful landscape	58.4	25.5	16	27.7	30.7	25.5	8	8	137	1	5	2.38	1.201
Prescribed fire improves wildlife habitat, creating better opportunities for hunting	22.2	20.7	57.1	8.9	13.3	20.7	30.4	26.7	135	1	5	3.53	1.263

Prescribed fire is necessary for a healthy forest ecosystem	15.2	22.5	62.4	8.7	6.5	22.5	31.2	31.2	138	1	5	3.7	1.224

Q26. How strongly do you agree with the following statements about using prescribed fire in your community?

				SD ←				→ SA				
	Neg.	**Neu.**	**Pos.**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**5 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
I trust the government to make proper decisions about the use of prescribed burning	33.8	29.5	36.7	16.5	17.3	29.5	23	13.7	139	1	5	3	1.274
The government should use prescribed burning as a tool whenever they see fit	43.5	30.4	26.1	19.6	23.9	30.4	18.1	8	138	1	5	2.71	1.203
Prescribed burning should be used infrequently, in carefully selected areas, and only with public approval	20.7	35	44.3	4.3	16.4	35	25.7	18.6	140	1	5	3.38	1.096
Prescribed burning is a valuable land management practice and should be widely adopted	24.8	38.7	36.5	11.7	13.1	38.7	22.6	13.9	137	1	5	3.14	1.171
Prescribed burning is a reckless management practice in this area because of too many negative impacts	63.8	22.5	13.8	37	26.8	22.5	5.8	8	138	1	5	2.21	1.229
My views have changed over time to be more accepting of prescribed fire in my community	31.9	41.3	26.8	13.8	18.1	41.3	18.1	8.7	138	1	5	2.9	1.122

Q27. What is the closest town or city to where you live?

Lost River	**Town**	**Perce**	**N**

Patoka River	**Town**	**(%)**	**N**

		nt (%)	
#1	Shoals	40.0	8
#2	Mitchell	20.0	4
#3	Bedford	10.0	2
#4	French Lick	10.0	2
N	20		

Pleasant Run	Town	Percent (%)	N
#1	Freetown	32.4	11
#2	Bloomington	17.6	6
#3	Nashville	14.7	5
#4	Spraytown	11.8	4
N	34		

Q28. How many years have you lived at this current property?

	Min	Max	Mean	SD
Years	1	67	21.91	16.021
N	143			

Q29. How many years have you been in this community?

	Min	Max	Mean	SD
Years	1	88	34.3	22.159
N	141			

#1	Paoli	50.0	16
#2	English	28.1	9
#3	Marengo	9.4	3
#4	French Lick	6.3	2
N	32		

Tell City	Town	(%)	N
#1	Leopold	24.6	14
#2	Tell City	15.8	9
#3	Derby	10.5	6
#4	English	7.0	4
N	57		

Q31. Do you own this home/property outright? Do you have insurance?

I own this home/property outright

	(%)	N
Yes	85.8	121
No	14.2	20
N	141	
Min	0	
Max	1	
Mean	0.86	

Q30. What best describes your residence on this property?

	(%)	N	*Other:
Multi-family housing	0	0	
Single-family house	80.4	115	barn w/ living quarters
Mobile home/trailer	17.5	25	old farm house
Other	2.1	3	small cabin
N	143		
Min	2		
Max	4		
Mean	2.22		
SD	0.462		

I have homeowners insurance or something similar

	(%)	N
Yes	89.8	123
No	10.2	14
N	137	
Min	0	
Max	1	
Mean	0.9	
SD	0.304	

Q32. What best describes the character of your current residential area?

	Percent (%)	N
Farm etc.	48.6	68
Exurban	32.1	45
Old town/settlement	9.3	13
Suburban	9.3	13
Urban	0.7	1
N	140	
Min	1	
Max	5	
SD	0.35	

Q34. Why did you decide to live in Southern Indiana?

	(%)	N
Change in marital status	6.3	9
New job	7.0	10
Closer to work or school/easier commute	3.5	5
Good schools	18.9	27
Good neighborhood	26.6	38
Close to outdoor amenities and recreation	28.7	41
Affordable land	28.0	40
Affordable housing	16.1	23

Mean	1.81
SD	0.993

Q33. What is the distance from your house to the nearest house outside your property line?

	Percent (%)	N
< 25 feet	7.8	11
25 - 100 feet	14.9	21
> 100 feet	77.3	109
N	141	
Min	1	
Max	3	
Mean	2.7	
SD	0.609	

Better cost of living	13.3	19
Ties to family, local community, and the land	63.6	91
Wanted a new/better home or apartment	7.7	11
To live in a place where people share my values	22.4	32
Beautiful scenery	61.5	88
Real estate investment	4.9	7
Privacy	53.1	76
An escape from busy urban life	29.4	42
Less government regulation and taxes	15.4	22
To be part of an exclusive community	4.2	6
Retirement	18.2	26
A second/vacation home	4.2	6
Born and raised here	7.7	11
Other	2.8	4
N	143	

Q35. What best describes your community for each of the following components…

				VP ⟷ VG									
	Poor	Avg.	Good	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	N	Min	Max	Mean	SD
Quality of life	1.4	17.7	80.8	0.7	0.7	17.7	41.8	39	141	1	5	4.18	0.795
Local economy	34	39.1	26.8	9.4	24.6	39.1	22.5	4.3	138	1	5	2.88	1.007
Places to visit or recreate	12.5	25.7	61.7	2.2	10.3	25.7	36	25.7	136	1	5	3.73	1.029
Availability of affordable housing	16	42	42	5.1	10.9	42	33.3	8.7	138	1	5	3.3	0.955

Local government	24.8	55.5	19.7	5.8	19	55.5	13.1	6.6	137	1	5	2.96	0.906
Communication among residents	14.4	40.3	45.4	2.9	11.5	40.3	28.1	17.3	139	1	5	3.45	1.002
Providing necessary services	23.5	45.6	30.9	5.9	17.6	45.6	24.3	6.6	136	1	5	3.08	0.959
Safety and crime	11.5	30	58.5	3.6	7.9	30	37.1	21.4	140	1	5	3.65	1.017
Cost of living	10.8	43.2	46	1.4	9.4	43.2	33.8	12.2	139	1	5	3.46	0.879
Community's change over time	19.8	55.9	24.2	5.1	14.7	55.9	19.1	5.1	136	1	5	3.04	0.868

Q36. Have you participated in any of the following activities during the past year? How often do you do these?

								N ⟷ VO							
	Y (%)	**N (%)**	**Low**	**Mod.**	**High**	**0 (%)**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**N**	**Min**	**Max**	**Mean**	**SD**
Attended a community event	81	19	19.3	35.4	45.4	6.2	13.1	35.4	23.1	22.3	130	0	4	2.42	1.154
Attended a public meeting	31.9	68.1	64.7	22.7	12.6	33.6	31.1	22.7	5.9	6.7	119	0	4	1.21	1.171
Served as an officer in a community org.	15.4	84.6	77.4	7	15.7	67.8	9.6	7	9.6	6.1	115	0	4	0.77	1.28
Contacted a local official	48.1	51.9	54.1	26.7	19.2	33.3	20.8	26.7	15	4.2	120	0	4	1.36	1.208
Served on local gov. committee or board	10.4	89.6	84.8	4.5	10.8	74.1	10.7	4.5	6.3	4.5	112	0	4	0.56	1.121
Voted in an election	91.2	8.8	7.2	5.6	87.1	4.8	2.4	5.6	11.3	75.8	124	0	4	3.51	1.048

Q37. Do you or any of your family visit public land for recreation or employment?

	Percent (%)	**N**
Yes	96.5	137
No	3.5	5
N	142	
Min	0	

Q38. How often do you visit these places?

	(%)	**N**
Once a year	5.3	7
Several times a year	61.7	82
Several times a month	12.8	17
Several times a week	11.3	15

Max	1
Mean	0.96
SD	0.185

Q39. How often do you interact with natural resource professionals at these places or in the community?

	Percent (%)	N
Never	13.4	19
Rarely	40.1	57
Sometimes	38	54
Often	8.5	12
N	142	
Min	0	
Max	3	
Mean	1.42	
SD	0.827	

Q40. Do you own land in your community?

	Percent (%)	N
Yes	90.1	128
Daily	9	12
N	133	
Min	1	
Max	5	
Mean	2.57	
SD	1.061	

Q43. Have you talked with anyone or received advice on your land in the past 5 to 10 years?

	(%)	N
Yes	30.5	39
No	69.5	89
N	128	
Min	0	
Max	1	
Mean	0.3	
SD	0.462	

Q44. Is any of your land actively enrolled in a conservation status?

	(%)	N
Yes	13.4	17
No	86.6	110
N	127	

No	9.9	14
N	142	
Min	0	
Max	1	
Mean	0.9	
SD	0.299	

Q41. How many total acres do you own in your community?

	Min	Max	Mean	SD
Acres	1	500	47.17	77.887
N	126			

Q42. If you own land does a portion of your income come from your property?

	Percent (%)	N
Yes	21.9	28
No	78.1	100
N	128	
Min	0	
Max	1	
Mean	355	
SD	0.415	
Min	0	
Max	1	
Mean	0.13	
SD	0.342	

Q45. How likely is it that you will parcel land in the next 5 to 10 years?

	(%)	N
Very Unlikely	52.3	67
Unlikely	20.3	26
Undecided	10.9	14
Likely	10.2	13
Very Likely	6.3	8
N	128	
Min	1	
Max	5	
Mean	1.98	
SD	1.27	

Q47. What kinds of management activities do you do on your land?

	(%)	N	
Timber production/harvest	39.8	35	**Other*
Stream bank improvements	11.4	10	bird feeders
Soil conservation/erosion control	44.3	39	hunting

Q46. Do you actively manage your land?

	Percent (%)	N
Yes	68.8	88
No	31.3	40
N	128	
Min	0	
Max	1	
Mean	0.69	
SD	0.465	

Grazing/pasture	37.5	33
Conventional farming	12.5	11
Landscaping/gardening	69.3	61
Organic farming	11.4	10
Pond for fish/waterfowl	38.6	34
Wildlife habitat improvement	38.6	34
Sustenance use (firewood, haying, etc.)	22.7	20
Outdoor recreation (ATV trails etc.)	34.1	30
Other	3.4	3
N	88	

rent for farming

Q48. When making management decisions on your land, how important are each of the following factors?

				Least ←				→ Most					
	Low	Mod.	High	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	N	Min	Max	Mean	SD
Economic Factors	25.9	23.5	50.6	10.6	15.3	23.5	23.5	27.1	85	1	5	3.4	1.3
Social Factors	40.7	40.7	18.6	20.9	19.8	40.7	8.1	10.5	86	1	5	2.7	1.2
Physical Factors	10.6	37.6	51.7	3.5	7.1	37.6	37.6	14.1	85	1	5	3.5	0.9
Operational Factors	28.6	35.7	35.7	15.5	13.1	35.7	21.4	14.3	84	1	5	3.1	1.2
Personal Interests	9.3	19.8	70.9	7.0	2.3	19.8	27.9	43.0	86	1	5	4.0	1.2

Q49. What year were you born?

	Min	Max	Mean	SD
Yr. Born	1925	1996	1955.6	14.1
N	134			

Q51. What best describes your race or ethnicity?

	(%)	N
White	99.3	141
African American	0.0	0
Native American	0.0	0
Asian	0.0	0

Q50. What is your gender?

	Percent (%)	N
Male	59.9	85
Female	40.1	57
N	142	
Min	0	
Max	1	
Mean	0.6	
SD	0.492	

Q52. What is your marital status? Do you have a family?

	Percent (%)	N
Single; no children	8.6	12
Single; with children at home	5	7
Single; no children at home	10.1	14
Married; no children	7.9	11
Married; with children at home	25.9	36
Married; no children at home	42.4	59
N	139	
Min	1	
Max	6	
Mean	4.65	
SD	1.623	

Q53. How many people live in your household?

Latino/Hispanic	0.0	0
Other	0.7	1
N	142	
Min	1	
Max	6	
Mean	1.04	
SD	0.42	

Q55. What was the highest grade of school you completed?

	(%)	N
No diploma		
High school graduate (includes GED)	30.5	43
Some college	27.7	39
Associates degree	14.2	20
Bachelor's degree	13.5	19
Graduate or professional degree	12.8	18
N	141	
Min	1	
Max	6	
Mean	3.46	
SD	1.412	

Q54. In general how would you describe your views and beliefs?

	(%)	N
Consistently Conservative	16.8	23

	Min	Max	Mean	SD
Number of people under 18?	1	5	1.91	1.083
Number of people over 18?	1	5	1.98	0.619

Q56. What best describes the current field that your occupation is in?

	Percent (%)	N	
Agriculture (forestry, farming)	2.9	4	**Other:*
Mining/Oil and Gas	1.4	2	veterinary assistant
Construction	10	14	library clerk
Manufacturing	5.7	8	scientific research
Wholesale or Retail	1.4	2	landscaping
Small business/Entrepreneur	1.4	2	part time ag work
Education	4.3	6	state/local government
Arts/Entertainment			disabled
Hospitality	1.4	2	helicopter mechanic
Public administration	1.4	2	domestic
Legal Profession			disabled miner
Law Enforcement	1.4	2	
Transportation	1.4	2	conservation; natural area restoration
Energy and Utilities	0.7	1	
Information and Technology	0.7	1	

Mostly Conservative	24.1	33
Mixed / Moderate	48.2	66
Mostly Liberal	8.8	12
Consistently Liberal	2.2	3
N	137	
Min	1	
Max	5	
Mean	2.55	
SD	0.95	

Q53. What is your average yearly household income?

	(%)	N
< $15,000	7.8	10
$15,000 to $24,999	12.5	16
$25,000 to $34,99	14.8	19
$35,000 to $49,999	21.9	28
$50,000 to $74,999	21.1	27
$75,000 to $99,999	11.7	15
$100,000 to $149,999	6.3	8
> $150,000	3.9	5
N	128	
Min	1	

Finance and Insurance	0.7	1
Health Care	7.9	11
Specialty Management	0.7	1
Design and Engineering	1.4	2
Military		
Student	0.7	1
Unemployed	3.6	5
Retired	41.4	58
Other	9.3	13
N	140	

Max	8
Mean	4.16
SD	1.79

Appendix F - Bivariate Correlations for Regression Models

Correlation Matrix for Wildfire Risk Perception[DV1]

		DV¹	*iv¹*	*iv²*	*iv³*	*iv⁴*	*iv⁵*	*iv⁶*	*iv⁷*	*iv⁸*	*iv⁹*	*iv¹⁰*	*iv¹¹*
Pearson Correlation (N = 101)	Wildfire Risk Perception[Dv1]	–											
	Sex[iv1]	-0.245**	–										
	Children[iv2]	0.069	0.117	–									
	Political Views[iv3]	0.063	0.012	-0.104	–								
	Income[iv4]	-0.305***	0.005	0.061	-0.06	–							
	Interface/Intermix[iv5]	0.169*	0.002	-0.02	-0.074	0.051	–						
	Forest Risks - Wildfire[iv6]	0.443***	-0.194*	-0.014	0.023	-0.234**	-0.034	–					
	Fuel Risks[iv7]	0.375***	0.038	0.001	0.087	0.05	-0.018	0.212*	–				
	Neg. Wildfire Perception[iv8]	0.229*	-0.122	-0.054	-0.146†	-0.171*	0.054	-0.008	-0.105	–			
	Knowledge of Rx Fire[iv9]	0.196*	0.002	0.033	-0.153†	-0.107	0.177*	0.109	0.082	-0.109	–		
	House - Type[iv10]	0.116	-0.046	-0.242**	0.023	-0.284**	-0.041	-0.167*	-0.091	0.159†	-0.252**	–	
	Community Participation[iv11]	0.261**	-0.032	0.075	-0.127	0.03	-0.123	0.047	0.196*	0.215*	-0.1	-0.029	–
	Insure[iv12]	-0.113	0.141†	0.019	-0.136†	0.383***	-0.094	-0.17*	0.003	-0.091	-0.084	-0.389***	0.206*

† sig. at the 0.10 level (90% confidence)
* sig. at the 0.05 level (95% confidence)
** sig. at the 0.01 level (99% confidence)
*** sig. at the 0.001 level (99.9% confidence)

Correlation Matrix for Negative Prescribed Fire Perception[DV2]

		DV²	*iv¹*	*iv²*	*iv³*	*iv⁴*	*iv⁵*	*iv⁶*	*iv⁷*
Pearson Correlation (N = 111)	Neg. Rx Fire Perception[Dv2]	–							
	Married[iv1]	-0.196*	–						
	Yrs in Community[iv2]	0.291***	0.057	–					
	Housing Proximity[iv3]	-0.195*	-0.063	0.011	–				
	Negative Wildfire Perception[iv4]	0.572***	-0.109	0.152†	-0.213*	–			
	Land Mgmt. Ignition Risk[iv5]	0.558***	-0.165*	0.058	-0.111	0.432***	–		
	Fuel Risk[iv6]	-0.145†	0.033	-0.058	0.154†	-0.009	0.176*	–	
	Land Attachment[iv7]	0.163*	0.046	0.07	-0.041	-0.004	-0.167*	-0.061	–
	Fire Should be Managed[iv8]	-0.38***	-0.043	-0.062	0.037	-0.268**	-0.182*	0.029	-0.058

† sig. at the 0.10 level (90% confidence)
* sig. at the 0.05 level (95% confidence)
** sig. at the 0.01 level (99% confidence)
*** sig. at the 0.001 level (99.9% confidence)